Neutral Citation Number: [2011] EWHC 3253 (TCC)

Case No: HT 06-04

IN THE HIGH COURT OF JUSTICE
QUEEN'S BENCH DIVISION
TECHNOLOGY AND CONSTRUCTION COURT

Royal Courts of Justice
Strand, London, WC2A 2LL

Date: 08/12/2011

Before :

THE HON. MR. JUSTICE RAMSEY

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Between :

	HANIFA DOBSON AND OTHERS	**Claimant**
	- and -	
	THAMES WATER UTILITIES LIMITED	**Defendant**
	-and- **THE WATER SERVICES REGULATION AUTHORITY ("OFWAT")**	Intervening

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Mr Stephen Hockman QC and Mr John Bates (instructed by **Hugh James**) for the **Claimants**
Mr David Hart QC and Mr Michael Daiches (instructed by **Osborne Clarke**) for the **Defendants**
Mr Ben Lask (instructed by **Ofwat) for the Intervening Party**

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Judgment # 2

Mr Justice Ramsey :

Introduction

1. In these proceedings some 1350 claimants ("the Claimants") who live in the vicinity of the Mogden Sewage Treatment Works ("Mogden STW") in Isleworth, Middlesex seek damages against Thames Water Utilities Limited ("Thames Water") for nuisance caused by odour and mosquitoes.

2. A Group Litigation Order dated 21 December 2005 applies to these proceedings. The Claimants are divided into two categories: those who have occupied properties as owners or lessees (Schedule A Claimants) and those who have occupied without any legal interest in the properties (Schedule B Claimants).

3. The Claimants served a Group Statement of Case on 9 March 2006 in which they pleaded that odours and mosquitoes from Mogden STW have caused a nuisance; that they have been caused by the negligence of Thames Water and that Thames Water have breached rights under Article 8.1 of the European Convention on Human Rights 1950 ("the Convention") and Article 1 of the First Protocol to the Convention. As a result the Claimants seek damages for nuisance and negligence as well as damages under the Human Rights Act 1998 ("the HRA") for breach of their Human Rights.

4. In the Defence to the Group Statement of Case, Thames Water raised various threshold defences to the claims. In particular, they contended that complaints about odour or mosquitoes from Mogden STW were complaints of a failure of its duties under the Water Industry Act 1991 (the "WIA") and the Urban Waste Water Treatment Regulations and that there was no common law remedy or remedy under the Human Rights Act to enforce those duties, whether in nuisance, negligence or under the HRA because such causes of action were precluded by the decision of the House of Lords in Marcic v Thames Water Utilities Ltd [2004] AC 42. In addition Thames Water raised various other defences in relation to damages and limitation.

5. As a result, I ordered that there should be the trial of certain preliminary issues concerning the "Marcic Defence", damages and limitation. I gave judgment in respect of those issues in Dobson v Thames Water Utilities Ltd [2007] EWHC 2021 (TCC); [2007] BLR 465 on 24 August 2007. The Court of Appeal gave permission to appeal on certain issues and in a judgment handed down on 29 January 2009, [2009] EWCA Civ 28; [2009] BLR 287, allowed the appeal in part.

6. Subsequently, this matter proceeded to a trial of test cases relating to 30 Claimants in respect of 10 lead properties to establish liability and quantum of the claims made by those claimants. In this judgment I consider those claims.

7. I consider, first, the background to the claim, including the history of Mogden STW, the process carried out there, the regulatory system which applies at Mogden STW, the work which has been carried out to that STW and other matters of chronology. I then consider the various parts of the plant, the allegations about the performance of the plant and then

allegations of odour negligence. After that I consider the allegations of mosquito nuisance, I then set out my conclusions on liability for those two complaints. Finally I turn to the question of quantum.

8. Mr Stephen Hockman QC and Mr John Bates appeared for the Claimants; Mr David Hart QC and Mr Michael Daiches appeared for Thames Water. Mr Ben Lask appeared on behalf of Ofwat in relation to the evidence of one witness, Mr George Day, called to give evidence about various regulatory matters.

Background

The History of Mogden STW

9. Mogden STW was originally built between 1931 and 1935 to cope with a population of 1.2 million people. It has since been expanded on a number of occasions in 1962, 1989 to 1991 and 2000 and now deals with sewage flows from an area bounded by Hendon in the North, Uxbridge in the West, Sunbury in the South and Chiswick in the East, a population of some 1.8 million people.

10. The works were originally operated by the relevant local authority. In 1974 they were transferred to Thames Water Authority and subsequently on 1 September 1989, when the water industry was privatised, they were transferred to Thames Water.

11. At privatisation of the water industry on 1 September 1989 the works at Mogden STW required much needed investment to comply with new regulations then coming into force regarding river quality.

The process at Mogden STW

12. It is convenient to identify the plant at Mogden STW and how that forms part of the sewage treatment process. The sewage arrives at Mogden STW through three main sewers: the Bath Road high level sewer, the Chiswick low level sewer and the Western low level sewer. The flow to the works is divided into two main streams: the East stream and the West stream, both treating the sewage by similar processes.

13. The sewage flow to the West side works is taken from the Bath Road sewer. The rate of flow coming into the West side is controlled by a hydraulic gate known as “Lucifer’s gate”. The flow rate to treatment in the West side is measured after Lucifer’s Gate. Sewage from the Chiswick and the Western low level sewers is measured in the main pumping station where it joins the remaining flow from the Bath Road sewer which has not passed to the West side works. This sewage then flows to the East side works. After screening and grit removal any flow in excess of the treatment capacity of the East side works passes over an overflow weir and goes to the storm tanks. The rate of flow is measured after this overflow weir and the amount to be treated is controlled from the control room using a valve known as “Penstock John”. Closing this penstock valve causes the flow level to back up which then leads to more sewage overflowing to the storm tanks. If the penstock is opened then the water level at the overflow weir is reduced and this in turn reduces the amount of overflow passing to the storm tanks.

14. When capacity for treatment is available, the storm tanks are then emptied by pumping the untreated sewage back into the East side of the works. If there is prolonged or high rainfall and the capacity of the storm tanks cannot deal with the overflow then the excess, partially settled sewage passes directly into the River Thames.

15. The sewage which passes through Lucifer's Gate in the West side inlet works or Penstock John on the East side inlet works then both go through a similar process of treatment on each side of Mogden STW, except that originally there were both Primary Settlement Tanks and Secondary Settlement Tanks on the East side which provided a two stage primary settlement process.

16. First the sewage goes through the primary settlement tanks ("PSTs") where sludge known as primary sludge is settled out. After primary settlement, the sewage then receives biological treatment by the activated sludge process ("ASP"). That process introduces air and uses naturally occurring micro-organisms in the sewage to treat the organic matter in the settled sewage by oxidizing and synthesising it. The air used in the process is blown into aeration units in the form of domes to keep the dissolved oxygen level in the sewage/bacteria mixture aerobic. That sewage/bacteria mixture is referred to as "mixed liquor". When the waste organic matter and ammonia in the sewage have been oxidised to a satisfactory level, the mixed liquor flows to the final settlement tanks ("FSTs"). Here the mixed liquor is allowed to settle and some of the sludge is then pumped back to the aeration units to seed the incoming settled sewage with micro-organisms so they can treat more incoming sewage by the ASP. This return cycle of sludge is called return activated sludge ("RAS").

17. The treated sewage in the form of a final effluent then overflows the FST weirs and is discharged to the tidal River Thames. Once the waste water has been treated by the process, as set out above, there is a need to treat the surplus activated sludge ("SAS") which is the sludge which is not recycled as RAS to the inlet of the ASP, as well as the primary sludge which has been settled out in the PST.

18. The primary sludge is pumped to a holding tank, known as the raw sludge holding tank ("RSHT"). This sludge is then thickened by a process which originally used paddles, known as Picket Fence Thickeners ("PFTs") but now uses drum thickeners so that the sludge is concentrated to have a solid content of about 6%. This sludge is then transferred to another holding tank, the thickened sludge holding tank ("TSHT").

19. The SAS from the FSTs was also originally pumped to form part of the same sludge stream as the primary sludge so that it was also thickened by using Picket Fence Thickeners. This process was modified, as I shall explain below, and the SAS is now pumped to a separate holding tank and is then thickened by the use of centrifuges until it also has a solids content of approximately 6%. It is then transferred to the TSHT, the same holding tank as the thickened primary sludge.

20. The combined flow of the thickened primary sludge and thickened Surplus Activated Sludge is then treated in a high-temperature pasteurisation process to reduce the pathogen content. This pasteurised sludge is them pumped to the sludge reception tank and from there it is then pumped into digestion vessels known as Digesters. In these Digesters the sludge is heated to approximately 35°C and mixed for a period of 12 to 14 days in the absence of air. This process of anaerobic digestion allows micro-organisms to grow in the heated sludge and break down the polluting organic matter and kill harmful bacteria.

21. After that period of 12 to 14 days the treated sludge is then pumped out of the Digesters to a transfer tank from which it is transferred by pipeline to the Iver South dewatering site where it is dewatered to a cake consistency of about 30% solids which is then used as a fertiliser and soil conditioner for agricultural land. This anaerobic digestion process provides, as a by-product, gas which is rich in methane. At Mogden STW this gas is combusted in spark-ignition engines which produces electricity used for the sewage treatment works with excess being fed into the National Grid. It is also used to fire the boilers which produce heat for the anaerobic digestion process. Any gas that is surplus to requirements is then flared.

The regulatory system

22. The Water Industry Act 1991 (the "WIA") contains the statutory regulation system for the water industry. The industry is regulated by the Water Services Regulation Authority ("Ofwat"), which was substituted for the Director of Water Services by s. 34 of the Water Act 2003. As part of the regulatory scheme, Ofwat have set funding priorities for new capital works in five year periods based on Asset Management Plans (“AMPs”).

23. In AMP1 (1989 to 1995) the Department of the Environment was responsible for setting the priorities, prior to Ofwat being involved. There was then a price review, PR94, to set the price limits for the next Asset Management Plan period, AMP2 (1995 to 2000). Similar price reviews, PR99 and PR04, were then carried out for the subsequent Asset Management Plan periods AMP3 (2000 to 2005) and AMP4 (2005 to 2010).

24. The Claimants, among other things, criticise Thames Water for their failure to apply or apply sufficiently persuasively to obtain funding during the price reviews for AMPs so as to obtain odour control measures at Mogden STW.

Work carried out at Mogden STW

25. Over the years since 1989, work has been carried out at Mogden STW by Thames Water and it is convenient, at this stage to describe briefly the work carried out as some of the changes to the plant feature in the complaints made by the Claimants.

26. In the period up to 1996 new plant was installed under the Key Change Programme (“KCP”) designed to upgrade Mogden STW. This involved, in particular, the installation of the Picket Fence Thickeners which were to act as additional sludge thickeners on the unthickened sludge. In addition, Thames Water replaced the old sludge pumps with new automatic pumps.

27. The PFTs were covered over in 1992 and in 1993 they were provided with their own Odour Control Units ("OCUs"), in the form of wet chemical scrubbers. These were then replaced in 1995 with bio scrubbers. Thames Water also introduced a degree of automated control for various elements of the treatment process during this period.

28. In the period between 1997 and 1999, Thames Water carried out a major extension to the West side works, known as Project 5523. The purpose of this work was to meet the requirements of the Urban Waste Water Treatment Directive ("UWWTD") by providing secondary treatment. The cost of the work was about £40m. The extension was designed to increase the capacity of Mogden STW to 810 Ml/d, so as to enable it to treat the equivalent of 2.0 Dry Weather Flows ("DWFs"), instead of the 1.4 DWFs which it had treated up to that stage. The design of the UWWTD extension work is the subject of criticism by the Claimants.

29. This extension of the West side works included new Primary Settlement Tanks, Aeration Lanes and Final Settlement Tanks, together with a system for dosing ferric chloride into the West side works by way of Chemically Assisted Settlement ("CAS") when flows were between 690Ml/d and 810 Ml/d. The extension was commissioned in the spring of 2000. This work also included the installation of a second belt thickener and associated polymer plant to assist the Surplus Activated Sludge treatment stream.

30. In the period between 1999 and 2002 Thames Water carried out improvement work to the sludge digestion plant, known as Project 2CKC, at a cost of some £20m. This was part of the preliminary work necessary to meet the requirements of the British Retail Consortium and of a document "Hazard Analysis and Critical Control Point", as well as what were to become the Sludge (Use in Agriculture) Regulations 2002. These new provisions required a significant reduction in the pathogens to be found in sludge before it could be spread on farmland which was used for producing food.

31. The digesters also needed refurbishing in order to be able to attain 12 days digestion at 32°C on a reliable basis, so that the second part of the project which involved the construction of a new sludge pasteurisation plant upstream of the digesters, could then be carried out. The refurbishment involved 16 of the 20 anaerobic digesters and the last few digesters were handed back to Thames Water after this work, in August 2002. The Claimants criticise the digester works for having had a significant effect on the sludge stream.

32. This work also included some odour related work at a cost of about £175,000, including the installation of odour monitors around the perimeter of the site and an Odour Control Unit for the area where sludge imported from other smaller works was mixed with raw sludge from Mogden STW, prior to being thickened.

33. In the period between 2001 and 2004 Thames Water carried out various items of work designed to assist control of odour. During the early part of the period Project 997D was carried out which involved the refurbishment of storm tank scrapers, the installation of a

scum weir on the East side storm weir and the relocation of the discharge point of the storm tank return to below the East side storm overflow.

34. A second phase of works, known as Project 50WC, was approved in May 2002. This involved the installation of one drum thickener, the replacement of penstocks and modifications to the storm water tanks by the installation of Amajets to improve the draining down and cleaning of the storm water tanks. In addition, a further three odour monitors were installed and improvements were made to scum removal on the Primary Settlement Tanks.

35. The total cost of Projects 997D and 50WC was some £3m. A third phase of the works was then carried out between March and December 2003, known as Project 3YMD. This work involved the installation of two more drum thickeners, a removal system on the East side Primary Settlement Tanks, improvements to the hydraulic system on the East side Secondary Settlement Tanks, refurbishment of the Odour Control Units on the Raw Sludge Mixing Tank and Picket Fence Thickeners, relocation of the sludge liquor return from the primary tanks to the aeration process, improvements to the storm tank hoppers and installation of permanganate dosing on the sludge stream, at a cost of £2m.

36. Also during this period, Thames Water carried out improvements at a cost of about £1.8m under Project 9MJD, including the renewal of the domes on the aeration lanes which formed part of the Activated Sludge Plant.

37. In January 2004 further works were carried out to improve the reliability of the scum pumps under Project 2H2F. Thames Water also carried out further works under Project 7P2F to increase the capacity of the sludge transfer mains linking the Primary Settlement Tanks to the sludge stream. Work was also done on the West side grit removal system and the storm tank weir.

38. Between 2003 and 2005 Thames Water carried out a pasteurisation and sludge thickening project, Project 1PDB(B5). As part of this project, the Picket Fence Thickeners were replaced with six drum thickeners and the two gravity belt thickeners for the Surplus Activated Sludge were replaced with centrifuges. All of this thickening equipment was also enclosed in a building served by new Odour Control Units.

39. In the period between 2005 and 2010 “cover and treat” works were carried out to the inlet works, the East side works and certain storm tank works under Project 59HF, at a cost of £40m. These works involved the covering of the East side Secondary Settlement Tanks, the East and West side inlet works and two of the eight storm tanks, plus venting of the enclosed air through dedicated Odour Control Units. These works were completed in 2008.

40. Negotiations took place between the Environment Agency and Thames Water as to the scope of the work associated with the Thames Tideway project which aims to alleviate the sewage flows into the River Thames. This led to Thames Water being required to increase the Flow to Full Treatment at Mogden STW from the presently consented level

of 690 Ml/d to 1064 Ml/d. In March 2005 the discharge consent for Mogden STW was amended, making this a quality obligation and hence a regulatory output to be met by Thames Water with funding permitted by Ofwat. This expansion of capacity was to be in two parts. First there was a project to convert circular Primary Settlement Tanks on the East side into Final Settlement Tanks and secondly a project to carry out a major expansion to the West side works.

41. The first part of this expansion was commenced in 2007, when Thames Water commenced Project 7H9G, the East side improvements project. This involved the conversion of the eight redundant circular Primary Settlement Tanks into Final Settlement Tanks. The physical works were completed in 2009 at a cost of £18m, but were not commissioned due to the high flows during the summer of 2009. As a result, the treatment capacity of Mogden STW was reduced by up to 30% until such time as the Final Settlement Tanks could be commissioned.

42. Since June 2008 Thames Water have been engaged in seeking and obtaining planning permission for Project 5X8F so as to allow expansion of the Works to a Flow to Full Treatment of 1064 Ml/d to meet its amended discharge consent. Thames Water contend that one of the reasons for the delay was that various Claimants were exerting pressure on the London Borough of Hounslow to refuse to agree the terms of the accompanying section 106 agreement containing various planning obligations placed upon Thames Water as a condition of the formal grant of permission. The section106 agreement was signed on 23 December 2009 and contained obligations concerning the construction to the extension, as well as governing the more general operation of the site including the phasing of the planned works to the sludge handling plant, the digester roofs and the various processes forming the extension to Mogden STW.

43. In addition, Thames Water agreed that they would implement the most recent draft of their Odour Management Plan and comply with their Mosquito Management Plan. Thames Water say that the existence of the section 106 agreement is relevant to the Claimants' claim for an injunction.

44. The total cost of the further West side expansion under Project 5X8F is some £149m and the project commenced in 2010 and is due to be completed in about 2013, at which time the treatment capacity at Mogden STW is intended to be extended to 1064Ml/d. An urgent reason for completing these works was the coming into force of elements of a discharge consent granted by the Environment Agency on 31 January 2007 but with effect from 1 April 2012. This requires a higher standard of treatment from the works than that set out in the 2005 consent.

Overview of the allegations of Odour and Mosquitoes

45. Essentially, the Claimants allege that the way in which Thames Water have operated Mogden STW from 1999 to 2009 has caused a nuisance by way of odour which is actionable because, in breach of their duty under Allen v Gulf Oil Refining Ltd [1981] AC 1001, Thames Water have failed to carry out the work and conduct the operation with

all reasonable regard and care for the interests of other persons. They also say there was a failure by Thames Water to make a sufficiently strong case to Ofwat to obtain funding to carry out necessary capital works or projects or that Thames Water failed to use their other resources to carry out those works or projects.

46. Thames Water says that a number of allegations made by the Claimants are not justiciable by this court in the light of the decision of the House of Lords in Marcic v Thames Water Utilities Limited [2004] AC 42 but, in any event, they have not failed in performing their Allen duty.

47. The Claimants also say that Thames Water failed in a number of ways in their duty properly to deal with Cp Molestus mosquitoes breeding at Mogden STW, including the eradication of those mosquitoes. Thames deny that they are in breach of the relevant duty.

48. The Claimants also contend that what has happened in terms of odour and mosquitoes is a breach of Thames Water's duties under the Human Rights Act 1998. Thames Water deny any breach of those duties.

49. The Claimants seek damages and an injunction and Thames Water deny that the Claimants are entitled to any such relief.

The Evidence

Factual evidence

50. I first heard evidence from a number of the claimants whose cases are being considered in this trial. They generally described their properties and gave evidence concerning the problems they have encountered in terms of odour and mosquitoes. The first witness was Sandra Weston who provided two witness statements. She lives at 2 Windermere House, Summerwood Road which she has rented since November 2003. The second and third witnesses were Hilary and Ian Thomson who have lived at 133 Haliburton Road since they purchased the freehold in December 1995. Mrs Thomson submitted two witness statements, Mr Thomson submitted one witness statement and there were witness statements from their children Owen, Carys and Huw (by Mrs Thomson on his behalf). The fourth and fifth witnesses were Stephen and Wendy Taylor who live with their daughter Rhiannon at 66 Weavers Close where they are leasehold owners. Mr Taylor submitted three witness statements and Mrs Taylor and their daughter Rhiannon each submitted one witness statement. Mrs Taylor's evidence was interposed during Mr Taylor's evidence.

51. The sixth witness was Rachel Addis who lives at 95 Worton Road. She submitted one witness statement. Ms Addis has owned the freehold of her property since November 2000. The seventh witness was Susan Ford who lives at 34 Arnold Crescent and she submitted two witness statements. She owns the property which was left to her by her father when he died in 1996. She lives there with her children Thomas and James Bannister. Her former partner, Clive Bannister, the father of Thomas and James, lived at

the property from December 1996 to May 2009. Susan Ford, Clive Bannister and James each produced one witness statement; Thomas provided two. The eighth and ninth witnesses were Paul and Shirley Fisher who live at 5 Worple Avenue. They purchased the freehold in July 1996. Mr and Mrs Fisher each provided one witness statement. The tenth and eleventh witnesses were Marc and Sharon Foord who live at 45 Elmer Gardens with their two daughters, Ciara and Niamh. Mr and Mrs Foord each provided one witness statements and Mr Foord submitted witness statements on behalf of Ciara and Niamh. The freehold of the property which they bought in May 1998 is owned jointly by Mr and Mrs Foord.

52. The final factual witness called by the Claimants was Peter Lloyd who until his retirement in October 2009 was employed as the Principal Officer of Water Quality by the Environment Agency. He produced three witness statements and gave evidence of his knowledge of Mogden STW since 1968 and his increasing involvement since 2007 in relation to consents.

53. Thames Water then called a number of witnesses who had been involved, over the years, with Modgen STW. They generally provided one witness statement. First they called Ian Cranshaw who is a Chemical Engineer and from September 1985 until October 2007 had various roles in Thames Water from Trade Effluent Officer to Senior Process Consultant for Sludge. He dealt with odour issues, in particular odour related to various items of plant. They then called Alan Crump who was the Production Manager at Mogden STW from January 1994 to November 2000. He produced two witness statements and gave evidence relating to the issues with the PFTs and sludge thickening. He also dealt with the general operation and maintenance of the plant in the period while he was involved at Modgen STW, including issues relating to both odour and mosquitoes.

54. The next witness was John Kingdon who is a biochemical engineer and joined Thames Water in 1989. In 2000 he became West London Operations Manager based at Mogden STW until he left in May 2003. He dealt with all the issues at Mogden STW in his period of involvement. Then Simon Mattin was called. He was the maintenance manager for Engenica, the subsidiary of Thames Water which carried out maintenance. He was involved in maintenance issues at Mogden STW. The next witness was Marnie Eccles who was the Mogden Catchment Manager from July 2003 to February 2004. She dealt with odour and mosquito issues during that period.

55. I then heard evidence from Keith Gardner who has been involved with Mogden STW since October 2004, first as Plant Manager from 2004 to 2006, then as Mogden Catchment/Process/Production Manager from 2006 to 2008, then as Area Operations Manager (Process South) from 2008 to 2009 and latterly as Strategy and Policy Manager for waste water assets. He produced two witness statements and dealt with odour issues and the improvement works carried out at Mogden in his period of involvement. The next witness was Paul Stocker who took over from Keith Gardner as Acting Area Operations Manager (Process South) in July 2009. He dealt with odour issues and the recent projects carried out at Mogden STW. Then I heard from Sian Thomas who became Area Operations Manager for Thames Water's Central Area, which includes Mogden STW, in

December 2009. She dealt with matters arising from the Claimants' experts' visit in December 2009.

56. The next witness was Simon Fishlock who was a Process Team Leader at Mogden STW between 2001 and 2003 and explained various operational matters during that period. I then heard from Brian Crathorne who worked in various roles in WRc plc and the Department of the Environment prior to being seconded to Thames Water to assist with their AMP3 submission to Ofwat. He then joined Thames Water in various roles dealing with submissions for funding in AMP4 and AMP5. He dealt with Thames Water's efforts to obtain funding. The next witness was Robin Clarke who was Waste Water Operations Director from June 2003 until September 2004 when he dealt with Thames Water's application for funding to alleviate sewer flooding as part of the PR04 price review. He dealt with odour issues and funding at Mogden STW. The next witness was Robert Williams who has been the Process Controller at Mogden STW since December 1999. He gave evidence on the operations of the plant. I then heard from Adrian Wallis who was involved in Mogden STW from 1999 to 2007 as the Process Controller for The West London Wastewater Region of Thames Water. He was involved in measurements of odour emissions and provided two witness statements.

57. The next witness was Roger Milne-Smith who from April 1999 was Area Support Manager and then from April 2005 the West London Maintenance Manager and was involved in Mogden STW from 1999 to 2009. He explained the plant maintenance regime at Mogden STW. The next witness was Peter Glass who was Lead Design Engineer for the UWWTD extension and advanced works (1996 to 2000) and for Project 2CKC the sludge improvement works (1999 to 2001) and senior project engineer for the planned effluent treatment plant extension (2004 to 2006). He dealt mainly with Project 2CKC. I then heard from Roger Matthews who is a Process Design Team Manager within Thames Water and provided some information for Thames Water's Process Expert concerning Project 5523, the extension to Mogden STW carried out in 1997 to 2000 and as to the Flow to Full Treatment and use of the Storm Tanks.

58. The next witness was Vidyaraj Koodie who was involved in the design of the UWWTD works at Mogden STW from 1995. He is currently a Senior Technical Director with Black and Veatch. Dr Koodie produced two witness statements and described the UWWTD design process. The next witness was John Ismay whose evidence was interposed. He has a degree in Zoology and a doctorate in the taxonomy of British species of Chloropidae (grass flies). He is a fellow of the Royal Entomological Society. With his wife, Barbara Ismay he runs an entomological consultancy which since 1992 has been sub-contacted to Bioscan UK Limited who were retained in 1991 by Thames Water to carry out surveys of mosquitoes living and breeding at Mogden STW. He produced three witness statements and gave evidence of his surveys and what Thames Water has done in relation to mosquitoes at Mogden STW. I then heard evidence from Marcus Summers who had been involved with Mogden STW since 1995, being a Process Controller since 1997. He dealt with the digester seals and digester foaming.

59. The next witness was Peter Spillett who was involved in Thames Water's applications for funding for AMPs 1 to 4, being Development Planning Manager, Strategic Planning Manager, Head of Strategy and Regulation, Environment and Quality Manager and Head of Environment, Quality and Sustainability at various times between 1988 and 2004. I then heard evidence from Helen Newman who had various roles in Thames Water prior to becoming a Senior Manager in 1999 and being Thames Water's Programme Manager for the 2004 Periodic Price Review for AMP4 and then being involved in meeting targets during the AMP4 period. The next witness was Andrew De Bell who joined Thames Water in 2000 as an Operations Manager but was first involved in Mogden STW in June 2003 when he replaced John Kingdon as Operations Manager for the West London area which includes Mogden STW. He left Thames Water in April 2007. He gave evidence of the operation and maintenance of Mogden STW during 2003 to 2007 and issues which arose in terms of odour and mosquitoes. The next witness was Mark Colvin who founded and was Managing Director of Greenhunter Limited and has now founded Bioguard Environmental Limited. From early 2000, except for a short period in 2007, his companies have had contracts with Thames Water to carry out biological and chemical treatments to control mosquitoes at Mogden STW. He provided two witness statements dealing with his involvement.

60. I then heard evidence from George Day who was called by Ofwat. He trained as a professional economist and was Director of Network Regulation from 2008 to 2010 with the Water Services Regulation Authority, Ofwat. He dealt with matters relevant to funding in AMP periods and in particular Ofwat's approach to Odour funding from AMP2 onwards.

61. The next witness called by Thames Water was Shelley Thomas (née May) who became the Production Manager at Mogden STW in November 2000 and then Catchment Manager in October 2001 until she left that post in July 2003. Ms Thomas provided two witness statements and dealt with odour and mosquito issues and the performance of various items of plant during her period of involvement.

62. A number of factual witnesses who provided witness statements were not called. The parties agreed an approach to such evidence which I have applied as appropriate. First, Thames Water accepted the contents of the witness statements of the Claimants who were not called to give oral evidence as being true or substantially true, save for the contents of Clive Bannister's statement. Mr Bannister's attendance was requested by Thames Water but he was not, in the event, called by the Claimants. Thames Water took no point on the admissibility of Mr Bannister's statement but reserved the right to make comment as to the weight to be attached to this statement in closing. Secondly, the Claimants accepted the contents of the witness statements of Thames Water's witnesses Adam Calderwood, Andrew Gosling and Jagtar Chonkaria as being true or substantially true. Thirdly, in respect of Barry Wyeth and David Taggart, given the incorrect description of pH testing in Mr Wyeth's statement and the faults reported in Dr Ismay's inspections and in disclosure documents, the Claimants say that they are describing the ideal situation at Mogden STW, not what actually occurred and they reserved the right to make comments as to the weight to be attached to their evidence in closing.

Expert evidence

63. I first heard evidence from the Claimants' experts dealing with Odour and Process Issues. In relation to Odour Issues, the Claimants called Mr Stephen Peirson who is employed as a Principal Odour Consultant by ADAS and has worked with ADAS and MAFF for more than 30 years since graduating in Agricultural Engineering. He is a Chartered Engineer and a Chartered Environmentalist. He had experience in odour emission measurements, odour abatement and odour impact control. He had been involved in work to measure and control odour and other emissions from sewage treatment works and a wide range of other sites. He has acted as an expert witness for the London Borough of Hounslow in appeals involving the abatement notice served in respect of Mogden STW. He has provided advice to MAFF and DEFRA in relation to the implementation of the EU Integrated Pollution Prevention and Control directive in England and Wales and more recently was the lead specialist "odour" contributor to draft DEFRA guidance for local authorities in relation to odour nuisance control.

64. In relation to Process Issues the Claimants called Mr Richard Hibberd who has a degree in Civil Engineering and qualified as a Chartered Civil Engineer and a Member of the Chartered Institute of Water & Environmental Management. Over the last 45 years, he has been involved in the design and operation of sewage treatment works. He worked for Yorkshire Water as Waste Water Co-ordinator/Environment Manager, having responsibilities for negotiation with the Environment Agency on river and coastal modelling, waste water treatment plant performance, implementation of UWWTD and sludge disposal control and monitoring, for development and implementation of wastewater treatment models used in AMP2 scheme development and for bidding for and implementation of PFI projects in Scotland and Holland. He has acted more recently as Technical Adviser to a PFI Contractor to Scottish Water for the design, construction and operation of 5 waste water treatment schemes in Scotland.

65. Thames Water then called their experts on Process and Odour Issues. On Process Issues they called Mr Richard Ratcliff who is employed by MWH UK Limited, a global environmental, energy and engineering consultancy as a Global Wastewater Technology Leader. He has a degree in Biochemistry and is a Chartered Member of the Institution of Water and Environmental Management. He has led the process design of several large wastewater treatment plants in the UK and overseas having similar process treatment streams to that at Mogden STW. In his 18 years' experience he has dealt with a large number of plants where odour control was required.

66. In relation to Odour issues Thames Water called Dr Alun McIntyre who is employed by Entec UK Limited, an environmental and engineering consultancy as Technical Director of the air quality group within the Environment, Policy and Safety department. He graduated in Environmental Science and then obtained a doctorate in public health engineering researching organic micro-pollutants in sewage treatment processes, which included taking measurements at Mogden STW. He carried out research and specialist commissions in the UK and overseas, including assessing the odour impact of moving the Perry Oaks sludge treatment facility to make way for Heathrow Terminal 5. He has

carried out projects relating to the measurement, assessment, modelling and abatement of odour from sewage treatment processes for UK water companies, local authorities and industrial and waste management companies.

67. Both parties then called their experts dealing with mosquitoes. The Claimants called Mr Clive Boase who has a degree in Applied Zoology and is a Fellow of the Royal Entomological Society and a Practising Member of the Academy of Experts. He is Secretary of the UK Mosquito Association. He initially worked for several insecticide manufacturers developing and evaluating insecticides, including those for mosquito control. He then worked as a full-time independent consultant on urban pest issues and lectured at the London School of Hygiene and Tropical Medicine. He has published papers and articles and contributed to books relating to various aspects of urban pests and pest control, including mosquito management.

68. Thames Water called Mr Ian Burgess who is a consultant medical entomologist and parasitologist specialising in the study of insects and other invertebrates of hygiene importance. Since 1984 he has been employed at and is director of the Medical Entomology Centre of Insect Research and Development Limited outside Cambridge. He has a degree in Zoology and further degrees in Medical Parasitology and Medical Protozoology and Immunology. He is a Fellow of the Royal Society of Health and a Fellow of the Royal Entomological Society.

69. In relation to valuation evidence, the parties each submitted reports from experts. The Claimants relied on the evidence of Graham Dickenson who is a Fellow of the Royal Institution of Chartered Surveyors and has practised for 38 years, initially with the Valuation Office then with Debenham Tewson (now DTZ) and now as a sole practitioner, specialising in the assessment and negotiation of compensation for land subject to compulsory acquisition. Thames Water relied on the evidence of Michael Donaldson who is a Fellow of the Royal Institution of Chartered Surveyors and a Member of the Academy of Experts. He has over 35 years experience of acting as a chartered surveyor carrying out valuations and surveys. After starting his career with Knight, Frank and Rutley, he founded Marquis & Co, a firm of chartered surveyors based in Twickenham where he continues to practise.

70. Neither valuation expert was called and the parties agreed that their evidence was accepted as their respective opinions on the valuation issues. However it was agreed that both parties were at liberty to make submissions as to the validity of those opinions.

71. In general I have been impressed by the expert evidence given in this case which has provided me with the necessary material to understand and decide the many issues which have arisen relating to odour, sewage treatment process plant, mosquitoes and valuation. Where I have preferred the opinions of one expert that has been based on an analysis of the reasoning by that expert rather than any inherent weakness in the opinion.

History of Odour at Mogden

72. When Thames Water took over on privatisation in 1989 they set up an odour group to investigate possible ways of dealing with odour emissions at a number of sites. This led

to various studies being carried out at Mogden STW by the Water Research Council ("WRc") in 1989 and 1990.

73. On 2 October 1989 the London Borough of Hounslow ("LBH") served an abatement notice on Thames Water in respect of the digesters at Mogden STW. This led to Thames Water starting the first in a series of works aimed at minimising the escape of gas from the digesters. The initial phase of works was carried out in 1990 to 1993 and Thames Water spent some £500,000 on digester refurbishment in 1991/2 and some £500,000 in 1992/3.

74. In 1990 the WRc carried out an investigation of odour problems at Mogden STW and Perry Oaks Sludge Treatment Works and produced a report in September 1990 ("Report UC885"). The objective of the investigation was to determine the sources of odour at Mogden and Perry Oaks STWs and the dispersion of the odour plumes off site. It was said that the reason for the investigation was that Thames Water had received a number of complaints relating to odour nuisance at both sites. The report stated that, if the sources of odour causing the complaints could be identified, process modifications and methods of odour control could be recommended to enable reduction of the nuisance.

75. The conclusions in the report were as follows:

> "*The main odour problems at Mogden STW are associated with digester operations.*
> *Further problems are caused by regular use of the storm tanks for balancing dry weather flow and insufficient cleaning of these tanks after emptying.*
> *A general septic odour is associated with the east-side works caused either by odorous substances from the incoming trade wastes or by septicity problems in the rising main.*
> *Odour problems at the inlet to the west-side works may be caused by the return of supernatant liquor from Perry Oaks sludge treatment works*."

76. The report further commented on the storm overflow in the east-side works in paragraph 5.3.2. It said

> "*Overflow of the storm weir occurs regularly even during periods of low inlet flow, the turbulence caused by the overflow increases the H_2S concentrations associated with the inlet area up to 20 ppb.*
> *One or more of the storm tanks is always in operation, and those recently emptied contain debris. H_2S concentrations of 8 to 25 ppb were measured on both occasions in the vicinity of the storm tanks. Although this is not as high as that measured in the vicinity of the digesters, the storm tanks have a high surface area, and hence a high emission rate of lower concentration odour is expected. This is supported by the H_2S values measured in Lynton Close, of between 5 and 10 ppb.*"

77. That report referred to recommendations for odour control which were presented by WRc in another report ("Report UC887"). That report was dated October 1990 and the summary of the recommendations was as follows:

> "*The major source of odour at Mogden Sewage Treatment Works is digester gas escaping into the atmosphere in the anaerobic digester area. Elimination of digester gas emissions would greatly reduce the overall odour problem at Mogden.*
> *It is recommended that the Mogden anaerobic digesters be sealed to prevent escapes of digester gas, either using flexible seals between the fixed wall and floating roof or the conversion of the tanks to fixed roof digesters. Satisfactory technology for the implementation of flexible seals on the existing floating roof digesters is not available but it may be possible to develop suitable sealing methods. If this is not possible, replacement by fixed-roof digesters may be required. As an interim measure, ferrous chloride dosing of the sludge prior to digestion is recommended to reduce the H_2S content of the digester gas and hence odour emissions.*
> ...
> *East side storm tank use during dry weather flow should be reduced to a minimum and improvements implemented for tank cleaning, removal of solids from the tank bases prior to storm water emptying, for example.*
> *Intense aeration of the inlet flows to both the east and west works may be possible to strip out odorous substances, hence reducing odour emissions over the entire works. The aeration air would require treatment by odour biofilter or bioscrubber. The common interest research programme U0703 will report the results of aeration trials in March 1991.*"

78. In particular, in section 2.1 of the report WRc elaborated on the odour problems associated with the anaerobic sludge digestion and in section 2.2 stated this about the East side storm water tanks:

> "*The regular use of the storm tanks, even during spells of dry weather, to balance excess sewage flow produces a significant odour along the east side of the works. Sewage from the rising main inlet to the east side works contains odorous substances, this is shown by the H_2S levels of over 20ppb around the inlet and over 75ppb within the screen house. Use of the storm tanks to balance this flow provides a large surface area for odour emission. Although the H_2S concentrations are low in comparison to the emissions from the digester, 10-20 ppb compared with values of over 400 ppb, the rate of emission owing to the large surface area is high and dispersion of the odours offsite occurs.*
> *It is recommended that the use of the storm tanks in minimised, especially during periods of warm, dry weather when the sewage is concentrated. If the use of tanks cannot be eliminated, the retention time of the sewage in the tanks should be reduced.*
> *Additional odour problems would be caused if solids remaining in the storm tanks are exposed during emptying. It is recommended that the sludge and debris be scraped out whilst still under supernatant cover.*"

79. On 21 January 1991 Ian Cranshaw, the process control engineer of Riverside STW wrote to Mr Dakers, the General Manager, S&ST of TWA. He set out a summary of the action taken and impending to combat odour emissions at the "worst case" works of Thames Water. At item 7 he dealt with Mogden STW. He said there had been a generally low

complaint frequency during the year. He referred to a general decrease in overloading due to refurbishment of aeration units which had allowed a reduction of odour in this area. He said that the refurbishment of digesters had reduced emissions of sludge gas and that a proposal had recently been put forward for a novel seal arrangement for the floating dome digesters and that this was under consideration. He said that AC generation was now partly commissioned and this meant there was no longer surplus sludge gas.

80. On 7 December 1993 there was a Customer Liaison Meeting at which it was stated that, in 1993, the level of odour complaints had fallen in accordance with a histogram attached to the minutes. It was said that the main areas of concern were the storm tank operation and the new sludge thickening plant. It was stated that improvements were in hand to improve control of storm tanks and that the thickening plant was currently awaiting process modifications.

81. Miss H. Dewhurst, a graduate Chemical Engineer employed by Mr Cranshaw, prepared an odour strategy report dated 9 November 1994. The history of complaints showed that in 1992 there were 159 complaints which were attributed to the installation of the sludge thickening plant as several problems had arisen during the subsequent operation of that plant. It was stated that in 1949 over 7,000 residents in Isleworth signed a petition claiming it was unacceptable to live with Mogden's "horrendous" smells. It recorded that in October 1989 100 residents had signed a similar petition which led to headlines in the local news paper, the Middlesex Chronicle and that, shortly afterwards, a Prohibition Notice had been served on Mogden STW by Hounslow BC relating to the sludge digester gas seals.

82. At section 3 she set out the parts of the process which were seen as potential sources of odour, together with actions taken or to be taken to deal with the nuisance. The parts were the sludge thickening plant, the digesters, the storm tanks. and the primary settlement tanks. At paragraph 3.1.4 of the report, dealing with supernatant liquors from the sludge thickening plant, Miss Dewhurst stated :

> "*Work carried out by R. Krishnan, Research and Development, in October 1992, identified a very large source of odour emitting from the wet well ventilation stack in the North end of the site. This was attributed to the return of liquors from the thickening plant. In fact the stack was found to be the largest single potential source of odour found at Mogden STW."*

83. At paragraph 3.2 in relation to digesters she stated:

> "*However, it is considered that the digesters are no longer the major source of odour. We have installed 2 different odour control devices in the digester area: "Lute" seals, where the dome sits on a water seal, as opposed to a sludge seal, have been fitted on two digesters. A third digester has a rubber seal fitted around the annulus of the dome.*
> *Current gas flow problems from the digesters to the Powerhouse are being addressed by an Engineering capital scheme. The occurrence of inconsistent bell heights is*

thought to be due to these problems, as well as to the weight differences between newly refurbished bells, and the older, more corroded ones.
We will continue to investigate all options: if the gas flow problems can be resolved, allowing us to minimise the bell heights of the digesters, then further odour control of individual digesters may not be necessary.
Refurbishment of the digesters will continue, on a rolling programme, until 1998."

84. In May 1995 Thames Water's Research and Development Department produced an odour guidance document (R9310) prepared by Mr E A Scholes and Mr C D Woods. The document was intended to provide background information on odour issues for operational managers and staff and guidance on an appropriate response to public complaints regarding odour nuisance through an "action plan". The document included a review of the available techniques for odour assessment, prevention and control and related them to other research and development documents and reports and engineering standard practice documents on odour.

85. At Section 7, Appendix 1 Odour Assessment, there was a reference at paragraph 7.2 to odour mapping using hydrogen sulphide and also at paragraph 7.3 to olfactometry where it stated:

> "*Where measurement of H_2S concentrations are thought not to be a reliable guide to the spread of odour then an alternative measure of odour concentration may be made using olfactometric analysis. A number of protocols exist for carrying out this type of analysis, but are based in using a panel of human "sniffers" to determine the number of times that a sample must be diluted to reach the threshold for detection.*"

86. At section 10, Appendix 4, there was a passage dealing with odour prevention. It stated that, in general, there were two key aspects to ensuring that odour nuisance was prevented where possible. The first option was to ensure that existing procedures were operated in such a way as to minimise the generation of odour. It stated that Thames Water had now defined and documented best operational practice which was implemented and regulated through quality management systems. The second option was to produce minimum odour by design. It stated that potential odour nuisance from new plant and processes must be assessed at the design stage and process operations reviewed and designed where appropriate to select the least odorous process option. It stated that examples of current standard practice options include raw sludge thickening in covered picket fence thickeners, separate thickening of surplus activated sludge rather than co-settlement in PSTs and the choice of fixed roof sludge digesters with bag-type gas holders to minimise biogas leakage.

87. In a document dated 23 June 1995 Mr T. H. Bane, the project manager for Project 19HB, Mogden STW Surplus Activated Sludge thickening, sought project implementation and tender approval. In relation to the project justification he set out this:

> "*Progressive deterioration of the Mogden digestion process over many years, coupled with increased works loadings and greater sludge make has put pressure on the entire process such that digestion detention periods and temperatures achieved are insufficient to give complete stabilisation of the sludge. Whilst Perry Oaks operated as a lagooned/air drying process this deficiency was masked: since installation of centrifuges to accelerate clearance of the site the underlying problem has manifested itself in odour generation.*
> *Recent installation of gravity sludge thickeners has been unsuccessful due to the presence of co-settled surplus activated sludge - a process constraint now fully recognised. The urgent need is to remove a substantial portion of the SAS from the gravity thickener stream and to provide an effective but temporary alternative to allow evaluation of performance, an immediate improvement on the digester feed sludge thickness and consequent reduction in odour problems.*"

88. In a document prepared by Mr C Davies, dated 14 September 1995, approval was sought for a budget to develop Project 5523, the extension at Mogden STW. It was stated at paragraph 2.4:

> "*Since the funding is within the AMP II 'K' deal any savings made on the cost of this project are in the interests of Thames Water and it is planned to seek and evaluate novel and innovative options to the conventional design, with the intention of reducing the capital costs.*"

89. At paragraph 3 under project justification it was stated:

> "*3.1 The Asset Strategy for Sewage Treatment indicates that the obligations mentioned as a requirement of the UWWTD must be met by 31 December 2000 and the obligations are funded under the AMP II 'K' deal.*
> *Recent investigations carried out during asset plan development have indicated that Mogden's overloaded treatment plant could not cope at present with an increase in flow to full treatment of some 23%. Storm tank capacity is 15% below that required. The West side inlet works does not provide screenings removal.*"

90. At a Mogden residents liaison committee meeting on 30 November 1995 Thames Water stated that they had implemented additional odour control measures of iron dosing of incoming sewage flows to reduce background levels of hydrogen sulphide "*known to be one of the main sources of odour nuisance from the works.*"

91. In a summary report dated May 1996 reporting on the process design and investigations it was concluded that the East side works could treat both hydraulically and in respect to load a flow of 450Ml/d. It was said that to sustain those levels it was essential that a secure sludge process stream eliminated sludge build up in the primary tanks. It also stated that trials had indicated that the West side works could treat both hydraulically and in respect to load a flow of 200Ml/d. It stated that the historical maximum Flow to Full Treatment was 536Ml/d and the trials had indicated that a flow of 650Ml/d could be successfully treated when flows of that magnitude were received.

92. On 2 July 1996 Dr Koodie set out his views on the number of FST needed for the extension project. He said:

> "*...the Table below indicates the number of FSTs required if 30m diameter tanks are used instead of 18m. Again, in all cases a MLSS of 300ml/g has been used for calculations and 23 FSTs for the existing West Side plant.*
> *As shown below the number of FSTs can be greatly reduced using the larger tank. Subsequently, I would imagine that the Capital cost can be reduced further. This in turn would favour the conventional and Chemical Dosing Options against the Nitrifying option when NPVs are considered.*"

93. In a later memo of 10 July 1996 he set out the number of additional FSTs required for a particular design SSVI and Flow, together with the ultimate cost of building them. He noted:

> "*The SSVI at Mogden generally runs between 40-60 ml/g. Therefore designing to 80ml/g would not be considered risky. If we designed the extension on an SSVI of 80 ml/g and for whatever reasons the SSVI increased to 100ml/g (i.e. as a consequence of insufficient air caused by an air blow, shock load etc) the maximum flow to the FST's will be reduced as indicated in Table 2.*
> ...
> *The number of additional FSTs is identical for both the Conventional extension and the Chemical Dosing options. In the case of the nitrifying plant no additional FSTs are required unless we design for an extension of 450 TCMD and using an SSVI of 120ml/g, in which case 3 FSTs are required.*"

94. On 15 July 1996 Ms Ann Weston wrote a project feedback report concerning Project 19HB in relation to SAS Thickening at Mogden. She set out in the summary as follows:

> "*This project provided for urgently needed sludge thickening trial at Mogden STW in order to confirm the preferred treatment process to improve digestion and control odour problems...*"

95. In relation to project justification she set out the following:

> "*Recent installation of gravity sludge thickeners has been unsuccessful due to the presence of co-settled surplus activated sludge - a process constraint now fully recognised. The urgent need was to remove a substantial portion of the SAS from the gravity thickener stream and to provide an effective but temporary alternative to allow evaluation of performance, an immediate improvement in the digester feed sludge thickness and consequent reduction in odour problems.*"

96. The scope of the work which was proposed was set out, as follows:

> "*At CTS the proposed scope consisted of the purchase and installation of a single Belt Thickener in an existing building and included for the minimum levels of support works to ensure safe and effective operation on a manual-only basis.*"

97. On 25 July 1996 Thames Water produced a draft project implementation proposal in respect of Project 5523 for the UWWTD extension to Mogden STW. As set out in paragraph 1.2.1, Mogden STW had to satisfy new obligations set by the Environment Agency to treat the equivalent of 2 DWF as compared to the current 1.43 DWF, as Flow to Full Treatment. It also had to provide fine screening (6mm) of all flows and the storm sewage had to have 2 hours retention at 3DWF. These obligations had to be satisfied by December 2000 at the latest. The draft report stated that the conclusion from the process/flow trials was that the Flow to Full Treatment proposed was 810 Ml/d (including Kew). At paragraph 1.6.3 it was stated:

> *The following concerns were identified for evaluation at the start of the dosing trials:*
> *(a) The effect on sludge pumping for both raw and digested sludges.*
> *(b) The increased production of raw sludge, although some reduction in the quantity of surplus activated sludge would also be expected.*
> *(c) Changes in sludge thickness and properties especially for digested sludge to Perry Oaks and likely effects on our current proposals for dewatering at Iver South/recycling to land and possible fallback of incineration at Mogden.*
> *Note: At the start of the trials it was envisaged that PST dosing would be a continuous process. During the project development it became clear that PST dosing would be most economic if it is only used at peak flow situations (say for about 30 days per year) and hence the effect on sludge quality etc will be variable. Therefore the proposed sludge stream needs to be able to deal with the full range of products without significant operational difficulties.*"

98. In that draft proposal Thames Water considered a number of treatment options. Option 1 was conventional treatment consisting of the "*Provision of additional PSTs, ASP and FSTs to conventionally treat up to 160 MLD with New Inlet Works (360 MLD); Flow split 200 MLD to existing, 160 MLD to new plant: 4 x 40m diameter PSTs; 5 additional aeration lanes and 15 additional 18m diameter FSTs*".

99. Option 2A consisted of chemical dosing and high primary settlement tank loading. It stated that this option aimed at optimising the final settlement tank provision and utilised the improved BOD removal (50%) from dosing to reduce the activated sludge plant and final settlement tanks required. At normal flows primary settlement tank dosing would be curtailed.

100. Option 2B was chemical dosing with low primary settlement tank loading. It was recommended because it provided an acceptable level of risk, the lowest cost option, adequate flexibility, maintainability and operability, scope for expansion to 900 MLD if necessary without additional primary settlement tanks and the minimum excavation/material disposal/contamination impact. It could also be expanded to a conventional plant if necessary.

101. In the final report dated 9 October 1996 Option 2B was retained as the recommended solution with three further reasons. First, it produced a sludge which could be readily recycled to land. Secondly, it was stated that, from the investigations, it was evident that the raw/digested sludge pump issues were manageable. In addition, providing that dosing was only needed intermittently, it was expected that the sludge could be incinerated if necessary. Thirdly, it stated that a regular source of suitable dosing chemicals was likely to be available for the foreseeable future and alternative chemicals were available if necessary, albeit at additional cost.

102. At Appendix F to the final report there was a process trial report which referred to chemically assisted sedimentation (CAS) precipitation trials which were concluded during the period February to May 1996 on the West plant at Mogden. At paragraph 6.0 in relation to the results of those trials it was stated as follows:

> "*BOD removal rate across the PSTs is historically found to be between 35-45%. The trial indicated that at high loading rates of 35$m^3/m^2/d$, a BOD removal rate of 60% could be achieved. This used Ferric Chloride (14.5%) at a dose rate of 50 ppm as product and the Polymer Magnafloc 1011 at a dose of 0.06 ppm. Greater BOD removal rates of up to 78% were attained at lower hydraulic loading rates.*"

103. At paragraph 8.0 various concerns were identified in relation to sludge as follows:

> "*a) the effect on sludge pumping for both raw and digested sludges;*
> *b) the increased production of raw sludge;*
> *c) changes in sludge rheology/properties particularly for digested sludge to Perry Oaks and the likely effects on our current proposals for dewatering at Iver South/recycling to land and possible fallback of incineration at Mogden STW.*
> *d) the effect on digesters.*"

104. In a project implementation approval document for Project 5523, dated 22 November 1996, the project scope was stated to be as follows:

> "*A new storm screening installation to be provided to the east side inlet works area.*
> *The west side plant to be provided with a new inlet works with 6mm screening and grit separation.*
> *A new west side works extension, including primary, aeration and final tanks.*
> *A chemical dosing system will be installed to the extended west side plant.*
> *A second belt thickener and associated polymer plant to reinforce the SAS treatment stream and provide for the additional sludges generated by other process changes.*
> *A range of minor H&S and integrity items as identified.*
> *Enhanced ICA/SCADA as necessary to maintain effective works control of the plant in its more severe operating conditions.*
> *Replacement final tank diffuser drums deferred from project 4LRB for further trials.*"

105. At a meeting with residents on 23 September 1998 Mr Crump produced a chart showing the number of complaints received in recent months. It was stated that there were 18 complaints in May as a result of problems with the sludge thickening plant but that there were only 3 odour complaints to Thames Water in July 1998, the lowest in 6 years. It was stated that there were also problems in September when the rains washed down the sewer debris which had accumulated during the dry weather.

106. On 20 November 1998 Miss Tracey Williams reported on items that should be attended to in order to improve the robustness of the Mogden sludge stream. She said:

> "Odour Control. There is a peat bed for the RSHT, two bioscrubbers for the PFTs and one bioscrubber for the TSHTs. All of these require attention. The peat bed is overdue for renewal
> ...
>
> *One key thing Alan [Crump] and I discussed was the potential for upsetting the PFT operation due [to] Odour problems, blocked drains and failing supernatant [Pumping Station]. Quite often because of one of these problems we can quickly deteriorate into a vicious cycle and recovery of the PFTs can prove an almost impossible task. It was only really the recent heavy rainfall that enables us to recover their operation after a poor few months.*"

107. On 31 August 1999 Mr Ian Cranshaw sent an email dealing with Mogden STW odour after a site visit he had made on 26 September 1999. He reported as follows:

> "***Bioscrubber serving the TSHT***
> *The GRP covers to the TSHTs were in average condition, three hatches had damaged hasps, one hatchway was badly damaged and left open due to the presence of a temporary bauer delivery pipe. In total the damage was enough to compromise odour capture.*
> *The Bioscrubber was in average condition, wash water was being displaced to drain at an appropriate flow rate unfortunately neither the fan or the pump was running at the time of the visit so I cannot comment on performance.*
> *The washwater connection was noted as temporary in the form of an unsupported lagged pipe descending down from the digester area.*
>
> *Recommendations:*
> *Make good the hatchways on the TSHTs.*
> *Remove the temporary Bauer connections.*
> *Operate the bioscrubber.*
> *Provide standby pump and fansets.*
>
> ***Bioscrubbers serving the PFTs and Liquor pumping station***
> *The initial appearance of the units is very poor this is largely due to ponding of sewage effluent around the units from a leaking flange on the main body of one unit.*

The local flooded area has accelerated the corrosion of the cable trays and supports in the area.
Both units had fans running but one unit showed no flow apparently due to a broken fan drive belt.
The adjacent unit showed a really low shaft speed on the fan, the motor had been replaced with a unit 50% smaller (in physical dimension).
Make up water was found to be running full bore to drain, although this does not present a process problem to the bioscrubbers it is clearly an unnecessary demand on the new washwater station.
The ductwork was in poor condition with some taped joints and a clearly asymmetrical system without balancing dampers between the PFTs.
The connection to the supernatant pumping station was via a partly buried 100mm duct at the extremity to the distribution system, it was evident from the gross corrosion of traywork above the station that this line does not give containment of odour.
In addition to the PFT connection there were Tees to the gravity drainage system served by the supernatant pumping station.
...

Hibernia unit serving the RSHT
This unit is newly commissioned by Engenica. It was in good condition throughout. Unfortunately the media was found to be dry. On investigation the ball valve serving the washwater break tank was found to be jammed closed with rag and sludge. The washwater tank was empty and the irrigation pumps had stopped on dry run protection.

Recommendations:
Review the screening provision on the washwater station.
Review the suitability of the 13mm ball float valve for screened effluent.

Discussion
At the time of the visit the level of abatement offered by the units collectively was close to zero. This was due to a number of reasons not including process capacity. Operations will need to review the maintenance and operating regimes for these units taking into account their age and condition. The bioscrubbers are in poor to average condition but due to the non-degradable nature of the filter medium and their GRP construction they are still suitable for extensive M&E refurbishment with an asset life restored of at least ten years.
The "Gaps" forwarded separately demonstrate there is no potential to serve additional sources utilising the existing assets. We will need to explore options after the report on ventilation is received from Alec Butcher."

108. On 9 September 1999 Adrian Wallis, then a Technical Support Manager with Thames Water spending about one third of his time at Mogden STW, reported on odour issues as follows:

"***Inlet Works – East & West***
The 20 ton skips are thought to be contributing to smell by the length of time screenings are sitting in the skips combined with the high temperatures generated within the containers by the sun beating down on the outside. Hales are investigating re other installations to see if these problems are encountered elsewhere. Drager tube checks for H_2S will be carried out by Adrian, although it is felt that smells will not be generated by H_2S rather than decomposing fat etc.
The potential for smell caused by sewage aerosols from the screens to be checked. Alan will be reviewing inlet wks area re smell with Chris [Collier] today.

Storm Tanks
Odours are generated due to storm overflow occurring more frequently than it would, as a result of increased flows to East side. Once the new works is commissioned and the West side is taking a higher proportion of flows this situation will improve.

Sludge
Odours have been caused by failure of the liquor pumping station and the diverted flows going to the Main PS. Currently temporary pumping arrangements avoid this by discharging to the PSTs as normal.

Sludge thickening issues are all to be addressed as part of the project. The centrifuge, once installed, will alleviate the overloaded PFTs. It is likely the bioscrubbers are overloaded by higher levels of H_2S than they were designed to cope with as a result of PFT overloading. The bioscrubbers themselves were checked by Ian Cranshaw last week and faults found: The calcified seaweed bed irrigation is not operating, Alan is chasing Engenica on this. One bioscrubber tower air fan was found to be too small and a replacement is being organised. The other unit is not operating and this is being rectified.

Chemical dosing
The ferrous dosing has been problematic, currently the dosing pump has failed. The ferric dosing system will be completed before the new year and will be the backup."

109. On 14 September 1999 Ian Crane wrote to Alan Crump to say that following the last five nights of odour detecting trials it had become "*very clear that we are self defeating with regard to odours and the new plant is not helping our cause. The site in general is smelling of activated sludge which is unavoidable*". He identified the other problem areas as follows:

"*3) East Side Skip Compactors require a daily washing procedure or additional mods to allow an automatic washing facility to remove foul stinking leachate from under the skips. Rag spillages must be cleaned up on a daily basis to prevent the rags from festering until they are removed.*
4) Maintenance of All Storm Water Tanks must improve and speed of repair to facilitate returning of storm sewerage with the tanks being scraped to minimise odour problems."

110. On 24 September 1999 an odour strategy meeting was held and a group was set up to reduce the impact of odour on the surrounding area of Mogden STW. As part of this odour investigation a Process Optimisation Group carried out an analysis which identified the specific areas which contributed to odour nuisance at Mogden STW and reviewed Thames Water's Best Process Practice (BPP) to identify whether Mogden STW complied with it.

111. On 8 December 1999, as part of this odour investigation, Mr Adrian Wallis provided an updated action matrix which set out the odour issues for various processes at Mogden STW and then set out proposed actions as follows:

(1) In relation to screens and screenings handling, for the East and West sides, the odour issue was "*excessive screening residence time in skips causing fermentation to take place*" and the proposed actions were: "*either reduce residence time in outer skips or use odour control chemicals. Trial of latter (global odour) likely to take place but not until warmer weather*".

(2) In relation to storm tanks and return, the odour issue was stated as "*length of time required to drain storm tanks. Now takes 14 hours each by pumping only – previously by decanting took 4 hours. This equates to 7 days to drain the lot as opposed to less than 2 days previously. Mechanical scrapers not now Best Practice*". The proposed actions were "*improve storm tank drain system. Peter Glass investigating fitting of larger pump impellers. Fitting of Amajets cost prohibitive. Storm problems should be much reduced once west side capital works complete*".

(3) In relation to storm tanks and return it was also stated that there was an odour issue "*Return storm liquors can back up into grit channel flumes causing smell due to accumulation of sludge*". In relation to that the proposed action was "*Operational practices?*"

(4) In respect of the bio-scrubbers the odour issue was "*Are they performing adequately?*" and the proposed actions were "*Independent performance checks (Ian Cranshaw) carried out and found satisfactory apart from access and minor deficiencies*".

(5) In relation to the digesters the odour issue was "*Loss of bio-gas from bell skirts (No 5 in particular)*". The proposed action was stated to be "*Operational issue. Not felt to be serious*".

112. In December 1999 Thames produced a Site Operational Manual for Mogden STW. It set out Best Operating Practice in relation to the plant. In relation to odour control units it stated the following: "*At present the bio-scrubbers are not sampled for H_2S checks as there is no safe access – to be rectified under future Projects. The bio-filter has yet to be fully commissioned and handed over.*"

113. In a report dated 18 December 1999 prepared by ABACAS they considered modifications to the existing mechanical ventilation systems for the picket fence thickeners. They concluded that the existing duct installation was not suitable for the preferred airflow rates and they attached sketch proposals to show alternative duct designs to uprate the system capacity.

114. When the action matrix for the Mogden STW odour investigation was updated on 21 February 2000, the odour issue in relation to bio-scrubbers was again "*Are they performing adequately?*" and it was stated that the action was "*Independent performance checks (Ian Cranshaw) carried out. Recommendations are in ABACAS report: renewal of fans and modifications to pipework.*" In relation to digesters it was stated that the action was as follows "*No 2 is losing gas from the skirt due to lightweight dome. Alan Crump is seeking advice from Black and Veatch re weighting the dome*".

115. In September 2000 Monitor Environmental Consultants Ltd prepared a report for LBH on odours at Mogden STW, following a site visit which took place on 31 August 2000. They referred to complaints relating to odour but reported that "*At the time of the visit no abnormal or excessive odours were observed. There was a build up of sewage sludge within the works due to refurbishment works and this should be eliminated as a matter of priority*". At Section 4.0 they stated as follows:

> "*The sewage arriving at the works inlet is anaerobic and is therefore likely to be prone to the production of odours at the primary sedimentation stage. Introduction of ferric chloride has proven successful in controlling odours and this chemical dosing may be required on a long term basis.*"

116. In November 2000 the Site Operation Manual included a reference to the ventilation of the raw sludge holding tank through a calcified seaweed type bio filter, to the picket fence thickener being vented through a bio scrubber tower (No 1) which removed odorous gases and that the thickened sludge holding tanks were ventilated through a bio scrubber tower (No 2).

117. On 21 December 2000 the Environment Agency issued modifications to the consent to discharge in relation to implementing the requirements of the Urban Waste Water Treatment Regulations 1994.

118. In June 2001 Thames Water wrote to residents to say that in the previous year the main cause of odour was the high levels of sludge build-up in the process as a result of the engineering works on site but that over the last few weeks the main reason for the continuing odour issue appeared to be from the utilisation of the storm tanks because of high flows since November 2000. They said they had experienced three times the rainfall of any year since records began and the storm tanks had been continuously in operation since November 2000.

119. In July 2001 Thames Water investigated work which could be carried out to reduce the odour generated by the storm tanks. In a summary on 13 July 2001 they proposed works which they said would achieve significant benefits including a scum baffle on the East side storm tank weir, relocation of the storm return so that it was not returned to the storm tanks, automation of the control for half of the storm tanks and installation of tank washing pumps for half of the tanks. They said that the ultimate level of odour reduction would be provided by covering the storm tanks and providing odour control units but would require a very large initial investment.

120. An odour survey was carried out at Mogden STW by Thames Water on 16 July 2001, in response to complaints. It concluded that the main source of odour was the new PSTs on the West side, with a problem with the scraper on one of the tanks at the time of the survey. It said: "*Other sources of odour were the East-side Primary and Secondary Sedimentation Tanks and both works inlets, settled sewage feed channel on the East-side to the B battery aeration plant and the area around the power house.*"

121. On 17 July 2001 Mr John Kingdon produced a Mogden STW Odour Strategy document. He set out the history and said this:

> "*There is no doubt that the Achilles heel of Mogden is the PFTs which were installed in approx. 1996, initial design calcs showed 6 were needed but the decision was taken at the time to try and push the process to utilise 4 only. Hence the process when co-settling is hopelessly overloaded and can't generally cope with the throughput rates required. This has a knock on effect of creating a backlog of sludge in the works which especially the Secondary Settlement Tanks (SSTs) causes a proliferation of odour as it gradually turns septic waiting to be removed from the tanks. This is particularly prevalent on the East side of the works.*"

122. Mr Kingdon then set out his view that the solution for the PFTs was to decommission them and install mechanical thickening for which onsite trails were then taking place with a small centrifuge unit. He referred to work which had been carried out in relation to the storm tank and set out his view which was similar to that in the 13 July 2001 document.

123. On 21 December 2001 Thames Water produced a Mogden Odour Study which set out the likely sources of odour at Mogden STW and contained proposals for reducing that odour. In the summary of recommendations it set out options to reduce the likelihood of odour being generated rather than covering and using odour control units to deal with the consequences. The options were

(1) Chemical dosing of the East side works and storm flows.
(2) Storm tank control modifications, Amajet cleaning and increased storm return capacity on tanks 1 and 5.
(3) Providing a penstock on the West side inlet works to allow the East side loading to be reduced.
(4) Modifying the East side SSTs to operate as PSTs.

124. On 22 March 2002 Thames Water produced a document with the title "Mogden Odour Study Further Work" which stated that the East side stream and the PFTs were the main sources of odour. They also said that because of increased flow from higher than average rainfall, the increased frequency of use of the storm tanks was also a source of odour. It proposed a number of options at a total cost of £7.7m. Those options were:
    (1) Odour monitoring and modelling.
    (2) Penstock to high level sewer inlet at the West side inlet works.
    (3) Conversion of the SSTs on the East side to PSTs, as the PSTs were overloaded and the SSTs were underloaded.
    (4) Storm tank control system modification, uprating of the return pumps and improving the cleaning system.
    (5) Covering and Odour control of the storm tanks.
    (6) New scrapers for the SSTs.
    (7) Improved drainage and odour control for Pumping Station 5 which pumped thickened sludge to the digesters.
    (8) Addition of ferric dosing to the East side process flow.
    (9) Upgrading the gas main to increase its capacity.

125. In due course this led to Project 50WC which included aspects of items (1), (2), (4) and (7).

126. On 30 August 2002 Thames Water produced a "Process Review of Mogden STW" which was started in April 2002. This identified a number of shortfalls. First, all seven blowers were in operation because of leaks in the air distribution main, reduction in blower output and deteriorating aeration because of a reduction in the efficiency of the diffuser domes. Secondly, during the Tideway agreement period when river flows were low, Thames Water agreed to achieve a daily average ammonia effluent concentration of less than 1ppm. Thirdly, Mogden STW could not treat the Flow to Full Treatment because of a fall off in the aeration performance and so regular peak lopping was needed using the storm tanks to balance the flows which exacerbated odour. Finally, there was a deficiency in the Return Activated Sludge flow in the battery C FSTs. They recommended blower maintenance and replacement, repairs of the air leaks and redoming of the aeration lanes to deal with the first problem and other improvements were noted including review of the PST de-sludging regime, improved pumps, control and piping for the scum removal and improvement of the operation of the storm tanks, scrapers and flushing mechanisms.

127. On 13 November 2002 Thames Water produced a report "Mogden East side Primary Sedimentation Investigation of Odour and Flow to Treatment Issues". It stated that recent odour complaints had led to investigations and the East side PSTs and SSTs had been identified as causing a significant odour nuisance. The report sought ways of reducing that odour.

128. In about August 2002 Thames Water's consultants, Black and Veatch, instructed a company called OdourNet UK Limited ("OdourNet") who carried out a site visit on 23 August 2002 and conducted a survey from 18 September to 4 October 2002. They took

odour samples which were analysed by olfactometry. They produced a report ("the First OdourNet Report") on 20 November 2002 which was to provide an odour impact assessment and evaluation of storm tank modifications at Mogden STW, following the service of an abatement notice and also perform an overall review to identify mitigation measures for odour. At the time modifications were taking place to the storm tanks.

129. OdourNet recommended that the following works should be carried out which they said were likely to reduce odour emissions by 65%:

- *Refurbish or replace the existing odour control plant serving the sludge holding and thickening tanks to ensure that odours extracted from these sources are abated by 95% prior to release.*

- *Modify the gas management system for collection of gas generated from the digesters to prevent release of gas directly to atmosphere. Prevention may require provision of suitable odour control (e.g. carbon filters) to ensure that any remaining releases are treated prior to entering the atmosphere.*

- *Optimise the control and management of return liquors to the East Side primary tanks from the sludge handling area of the works, and adopt a robust sludge and scum removal scheme within the tanks to ensure effective removal of sludge and prevent occurrence of septic conditions.*

130. In January 2003 Black and Veatch produced a technical specification for Project 3MYD which included a hydraulic model of the East side works; work to the East side PST scum removal and pumping to the RSHT; individual isolation of the East side SSTs; installation of a second temporary drum thickener; refurbishment of the thickener area odour plants; installation of a temporary pipeline to allow liquors to be returned to the aeration lanes as well as head works; replacement of the RSHT mixer and additional work to clear the storm tank sludge hoppers.

131. On 4 March 2003 Thames Water produced a completion report in relation to Project 2CKC, which included work to the PFTs and upgrading of eight digesters.

132. On 5 March 2003 Mr John Sexton, Thames Water's former Managing Director wrote to Mr Philip Fletcher, Ofwat's Director General with a briefing on odour issues at Mogden STW. He said that there had been significant investment at Mogden STW but that the AMP3 determination had contained no specific allowance for odour at any site but that Thames Water were spending in excess of £5m in that period to manage the odour problem at Mogden STW. He said that currently Thames Water had a £3m scheme in progress to deliver improved storm tank emptying.

133. A Mogden Operational Review was carried out by Thames Water on 29 and 30 July 2003 and Ms Marnie Eccles produced a report on 13 August 2003 which identified, amongst other things, odour problems. There was then a discussion and Mr Andrew Gosling added comments setting out what action was necessary.

134. Following the implementation of various improvements at Mogden STW during 2002/2003 OdourNet were commissioned to evaluate the impact of the improvements and further opportunities for improvements. They carried out a survey between August and October 2003 and produced a report in November 2003 ("the Second OdourNet Report").

135. They reported that the improvements had achieved varying levels of success in reducing odour emissions. There had been an 86% reduction in odours from the Sludge handling and treatment areas, making an overall 30% reduction. The modifications to the storm tanks had reduced odours by 25%, making an overall reduction of 3%. They identified further improvements for the purpose of Thames Water's submission PR04 which would be required "*to reduce the level of exposure to odours experienced by local residents to an acceptable level (defined in the absence of more robust data as the Newbiggin criterion of* $5ou_E/m^3$ *98th percentile)*". They said that, as a minimum, application of cover and treat solutions would be required to the East and West side inlet works, the East side PSTs and SSTs, the West side rectangular PSTs and the storm tanks.

136. On 26 January 2004 Thames Water produced a "PR04 Odour Control Proposal" for Mogden STW. It set out work in the form of covering and treating the Inlet Works, Storm Tanks and Primary Treatment which would reduce odour by 70.4% at a cost of £76m.

137. On 26 February 2004 Mr Robin Clarke of Thames Water sent an internal email in which he referred to a site inspection which he had carried out on 17 February 2004. He said "*unfortunately my observations are that, collectively, we are falling well short of 'best practical means'*." He referred, amongst other things, to half of the Amajets in one of the storm tanks not rotating, half of Battery D being out of service for civil repairs, half of the replaced joints on the air main for Battery A leaking and the PST new scum removal system having limited success.

138. In September 2004 OdourNet produced a report which repeated the odour measurement and impact assessment study which they had carried out in 2002 and 2003. They commented that the reduction in odour levels was probably due to the lower odour potential of the incoming influent rather than any operational changes and that the 2002 and 2003 studies better reflected the worst case Summer conditions at Mogden STW.

139. On 31 March 2005 the Environment Agency produced a Modification of Consent to Discharge to Thames Water which amended the volumes of discharge and the BOD and N values of the discharge.

140. In June 2005 Thames Water produced an Odour Management Plan for Mogden STW. It stated in the introduction that:

> "*The purpose of this document is to define how the potential and actual generation of odour from the Mogden STW site is identified and, as far as reasonably practicable, controlled.*

> *The format is in line with that adopted for other Thames Water sites. DEFRA has issued a draft Code of Practice, and guidelines on preparing Odour Management Plans are being developed by UKWIR as part of a Best Practicable Means Guide for odour control at wastewater treatment sites.*"

141. That Odour Management Plan was then revised a number of times with Revision 6 being produced in December 2007 and Revision 7 in December 2008. In particular, the Odour Management Plan included trigger levels in ppm of H_2S for action in respect of the average exhaust readings of each of the Odour Control Units.

142. In September 2008 OdourNet conducted a comprehensive odour measurement exercise at Mogden STW, followed by dispersion modelling. The odour measurement involved measuring emission rates from key processing activities in odour units, ammonia and hydrogen sulphide, measuring odour abatement efficiency of the existing odour control units and assessment of the relative offensiveness of odour emissions from the various aspects of the process.

143. In January 2009 OdourNet produced a final draft report which set out their odour assessment from that study which had been commissioned by Thames Water to evaluate the odour control measures which had been carried out and whether the target reduction of site emissions of 66% had been achieved. They reported that the 2008 survey indicated total site emissions of 58,000ou_E/s, compared to some 606,000ou_E/s in 2003 and 327,000ou_E/s prior to commencement of the odour control project in 2005. It stated that the reduction in site emissions was directly attributable to measures implemented in that project to enclose and treat emissions from the West side inlet works., the East side inlet works, from the East side PSTs and the first fill storm tanks, together with improved cleaning and odour management procedures within the remaining open storm tanks. They concluded that the 66% reduction had been achieved.

144. On 17 December 2009 LBH served three abatement notices on Thames Water in respect of the digestion of sewage sludge, the operation of the odour control unit serving the pasteurisation plant and the management of the storm water tanks. On 6 January 2010 Thames Water lodged appeals against the abatement notice for the complaint about management of the storm water tanks.

145. On 19 December 2009 OdourNet produced a report on tests carried out to Odour Control Units from 29 September to 1 December 2009. Those included the main pumping station biofilter, the East side works OCU, the West side works OCU, the sludge thickening building OCU, the pasteurisation OCU, the sludge imports OCU both during quiescent operation and during tanker discharge and the sludge transfer OCU.

146. On 23 December 2009 LBH and Thames Water entered into the s.106 Agreement in respect of the grant of planning permission for work at Mogden STW which was subject to covenants by Thames Water in relation to various matters including matters relating to odour control and mosquito management.

147. I now turn to consider, first, the allegations made by the Claimants in respect of each item of plant. These were set out in a Schedule of Failings which the Claimants produced at the commencement of the trial. I then consider the pleaded allegations of negligence in relation to odour.

The allegations in relation to Odour at Mogden STW

148. It is convenient to deal with the items of plant at the STW in the sequence in which they are dealt with in the Schedule of Failings.

The Inlet Works

149. There are four aspects of the inlet works which the Claimants allege gives rise to liability for nuisance. These are periodic sewage septicity, periodic recycled liquor septicity, exposed sewage in large open areas and problems from the screenings and grit removal.

Inlet sewage septicity

150. There is a difference of view between the experts as to whether there has been any septicity in the sewage coming into the inlet works. It is clear that limited testing has been carried out to establish levels of H_2S in the incoming effluent. However, as the Claimants state, there have been a number of references in the documents to there being a problem with septicity in the inlet works.

151. The WRc report (UC885) of September 1990 which considered the sources of odour at Mogden STW came to a number of conclusions including the following:

> "*a general septic odour is associated with the East-Side works caused either by odorous substances in the incoming trade wastes or by septicity problems in the rising main*."

152. Some five years later on November 1995 at a Mogden Residents' Liaison Committee Meeting, Thames Water informed the meeting that they had implemented additional odour control measures of iron dosing of incoming sewage flows "*to reduce background levels of hydrogen sulphide, known to be one of the main sources of odour nuisance from the works*."

153. Some five years later again, in September 2000, Monitor Environment Consultants Limited prepared a report for the LBH. In that report, based on a visit to the works, they stated that the sewage arriving at the works inlet was anaerobic and therefore likely to be prone to the production of odours at the primary sedimentation stage. They said that the introduction of ferric chloride had proved successful in controlling odours and that chemical dosing may be required on a long-term basis.

154. In December 2001 the Thames Water Mogden project team produced a report detailing the likely main sources of odour at Mogden STW together with proposals for how the odour could be reduced. At paragraph 2.1.1 they dealt with the incoming sewage condition. They reported that, due to the size of the Mogden catchment area which served

a population equivalent of 1.8 million, there was a potential in the system for some of the incoming flow to become septic, particularly in periods of low rainfall. They therefore considered that, in dry summer periods, the effect of any septicity in the incoming flow would increase the likelihood of odour complaints. They made recommendations on options which would have the largest effect on reducing the odour from Mogden STW. One of those recommendations was to carry out additional $FeCl_3$ dosing to the East side inlet and storm weir to reduce odour on the East side and in the storm tanks and to reduce corrosion of the Combined Heat and Power plant.

155. In a later report dated March 2002, following the issue by LBH of the Odour Abatement Order, Thames Water repeated these views on the potential for the incoming flow to become septic and, as Option 8, again proposed the addition of ferric sulphate to the East side process flow. They stated that, if the sewage was not dosed, high concentrations of hydrogen sulphide would be present throughout the process stream.

156. In June 2009 on a regular inspection carried out jointly by Thames Water and the London Borough of Hounslow it was reported that odour levels in excess of the trigger levels had been recorded. In relation to this, it was stated that, prior to the recent rain fall, the weather had been warm and dry and that this was likely to have caused a higher level of septicity in the sewers. It was also reported that because of the septicity of the sewage, the storm water flows had been more odorous that usual.

157. Those documents would indicate that there was a concern about the septicity of the incoming flow particularly in periods of low rainfall.

158. There are though, very few test results for hydrogen sulphide at the inlets to Mogden STW. There was an exchange of emails in April 2003 when Adrian Wallis reported to Ian Cranshaw that they had taken samples on 15 April 2003 and had found sulphide levels of less than 0.1mg/l. On 30 April 2003 Mathew Ladds, a Thames Water process engineer at Mogden, said that Barry Wyeth had been regularly measuring the dissolved sulphide levels with negligible traces of the compound. Adrian Wallis responded to this on 1 May 2003 and said that Barry Wyeth had told him that he had obtained a reading of 0.2 mg/l sulphide but that was the highest so far. He said he would like one to two checks per week over the coming hot months to see if any trend upwards developed. Adrian Wallis said that these were the only exchanges on sulphide levels and that spot tests for dissolved sulphide were carried out over several weeks on crude sewage after April 2002. He said that from memory no more than 0.1mg/l was measured and the view expressed at the time by Mr Cranshaw was that levels above 1mg/l were indicative of septicity. When Mr Wallis was asked questions about this he indicated that this was the only period where testing had been carried out and he thought that if there had been a problem with septicity it would have been apparent during that period.

159. Mr Hibberd was surprised that there was not more data. Dr McIntyre asked for but was not provided with any further data but was informed that septicity was not a problem at Mogden.

160. It is evident that a decision was made to carry out ferric chloride dosing of the inlet stream at a rate of, on average, 1mg/l. This level of dosing would only be able to oxidise and fix negligible levels of dissolved sulphides in the inlet stream and I accept Dr McIntyre's evidence on this at paragraph 26 of his first report. Mr Hibberd considers that up to 10 milligrams per litre would be required in the summer and that dosing should have been at least 5mg/l to have an effect on odour. Mr Hibberd considers that the main reason for carrying out the ferric dosing was to protect the Combined Heat and Power engines and that if odour control had been a priority then dosing with calcium nitrite would have been used.

161. I have considered what Dr McIntyre says at paragraph 28 of his first report and consider that he is likely to be correct in his view that dosing with nutriox (calcium nitrate) would be more appropriate for use in rising mains than as dosing for the inlet works.

162. My overall conclusion on this aspect is that, as indicated in the documents, there were, particularly at times of low rainfall, periods when it is likely there was septicity in the incoming flow. The lack of records by Thames Water on this aspect is surprising and given the contemporary documents I do not consider that the lack of testing was justified by or establishes any lack of septicity. I accept that, as Dr McIntyre explained, there is a process of oxidization as the sewage flows down gravity mains but that process would be less likely to occur during periods of low rainfall and higher temperatures which, as Mr Hibberd says, are likely to occur in August and September of each year.

163. I therefore conclude that there were periods when the inlet stream was septic. As Thames Water failed to take steps to measure the septicity of the inlet flows it is likely that this septicity caused odours from the inlet works each year until the inlet works were covered in September 2007. This is also borne out by the records of the East side inlet works pumping station Odour Control Unit which shows that in the period between February 2004 and October 2007 high concentrations of hydrogen sulphide were measured.

164. There appears to have been no proper system for monitoring and dealing with inlet septicity in the period up to September 2007 when the inlet works were covered and the air treated in Odour Control Units. I do not consider that Thames Water acted in a reasonably competent manner in the way they dealt with this problem and I consider that they failed to conduct operations at Mogden STW with all reasonable regard and care for the interests of other persons, including the Claimants in this respect and that this meant that odours were emitted from the inlet works.

Recycled Liquor Septicity

165. Sludge liquors from the Picket Fence Thickeners were returned to either the East side inlet works or the East side PSTs in the period up to December 2003 when the liquors were then sent to the inlet of the Activated Sludge Plant. Mr Hibberd considers that the sulphide concentration in these liquors could reach over 100 mg/l and that this would add significantly to the inlet septicity which, he suggests, after the addition of these return liquors could contain an extra 2mg/l of hydrogen sulphide.

166. Dr McIntyre considers that, as the sludge liquors represent only about 2% of the flow at the inlet works and would conservatively have dissolved sulphide of 5mg/l then the addition would only add 0.1mg/l dissolved sulphide to the influent flow rate. Dr McIntyre explained at paragraph 44 of his first report that Thames Water installed a sludge liquor permanganate dosing facility and operated it for a short period in 2003. He said that the system had operational problems and was not very effective so it was only operated for a short period of time. He expresses the view that in his experience dosing the sludge liquors is very rare. However it is evident from the fact that they installed and operated the plant that the impact of the sludge liquors was viewed by Thames Water as having some importance.

167. However, whilst there may have been septicity in the liquor which was recycled to the East side inlet stream or primary settlement tanks in the period up to December 2003, I am not satisfied that the contribution of that septicity would have any significant effect on the septicity of those processes. There was evidently some concern which led to the provision of a dosing facility and to the alteration of the way in which recycled liquor entered the process stream. That shows that Thames Water took some steps to deal with any problem and I do not consider that Thames Water failed to conduct operations at Mogden STW with all reasonable regard and care for the interests of other persons, including the Claimants in dealing with recycled liquor. In any event, I am not satisfied that this contributed to odour problems at the East side inlet works or at the primary settlement tanks in the period up to December 2003.

Covering the Inlet Works

168. The Claimant's contend that in the period until the covering inlet works were carried out in 2007 and early 2008, the effect of the periodic sewage septicity and recycled liquor septicity was to give rise to odours for which chemical treatment would not be 100% effective.

169. In essence it seems to me that either a proper regime of testing and chemical dosing of the inflow at the inlet works should have been carried out to reduce the septicity which periodically occurred, or, if that were not done, then the solution would be to cover the inlet works and remove the odour by an odour control unit. Thames Water decided to carry out the latter in 2006 and 2007 and I do not consider that they failed to conduct operations at Mogden STW with all reasonable regard and care for the interests of other persons, including the Claimants by not carrying out that work earlier. Rather I consider that they should have carried out proper testing and chemical dosing to avoid the odour nuisance caused by the septicity until they covered and treated the inlet works.

Inlet Works Screenings and Grit Removal

170. This concerns two separate aspects relating to the inlet works. First it relates to the way in which skips containing putrescible material from the screenings were dealt with. Secondly it concerns the way in which grit was spread on hard standings on the West side works so that it could be dried out before being disposed of into skips and taken away.

171. The Claimants say that skips containing material from the screenings were left uncovered and that the number of skips indicates that they were not regularly removed. Thames Water say that there is insufficient evidence to indicate that they acted unreasonably. They point to the evidence of Mr Crump, Mr Kingdon and Mr Williams and say that the skips were removed regularly, that they were covered and that any spillages were remedied. They say any evidence to the contrary is merely "snapshot" evidence and if there were failings on the odd day it would not amount to a nuisance.

172. In the Mogden Odour Study dated 21 December 2001 under the heading "Local odour sources and recommended solution" it is said at paragraph 2.2.8 that Thames Water should reseal, cover and carry out odour control to reduce odour from the skips. It is also said that the existing skip areas on the East and West sides of the works can create odour sources particularly in the Summer. At paragraph 2.2.9 it was said that "odour is generated due to the quantity of grit stored in open skips and the solution was to cover the skips and reduce storage" and that there were currently large numbers of grit skips stored on the East side of the works which were uncovered.

173. When Mr Peirson visited the site on 17 December 2009 he noted that there were seven grit skips with temporary covers lined up on the concrete apron at the West side inlet works and these can be seen on the photographs within his report. There is also a note dated 19 June 2005 by Mr Stephen Taylor, one of the Claimants, which was heavily relied upon by the Claimants which stated as follows:

> "Odour in Weavers Close the entire weekend. Inlet Weir Screening House Shutter doors left open again!!! Skips of rotting waste left on site in the baking sun for the weekend. Another weekend ruined due to Thames Water's gross incompetence. Quite pathetic."

174. It is evident that this was a problem identified when matters were considered in December 2001. The fact that similar problems were noted when Mr Peirson attended site some eight years later would indicate that these are not isolated events. This is also supported by Mr Taylor's note. I consider that these occurrences evidence a lack of proper management control over the way in which skips containing material from the screenings were covered and removed from site. In this respect I consider that Thames Water failed to conduct operations at Mogden STW with all reasonable regard and care for the interests of other persons, including the Claimants. In my judgment there were a significant number of occasions when skips containing material from the screenings were left uncovered and not removed efficiently, leading to odour emissions.

175. In relation to the drying of grit on the hard standings on the West side of the works, this seems to have been a more recent practice. It was noted by Mr Peirson on his visit on 17 December 2009. In addition it was noted on the joint inspections between Thames Water and LBH carried out on 18 July 2008 and 17 June 2009.

176. Again Thames Water say that there is not sufficiently cogent evidence to show that they acted unreasonably. They rely on the evidence of Mr Robert Williams. His evidence on

Day 7 was that the grit on the hardstanding might be grit removed from the screen house because of a defective piece of equipment. He said that this occurred when grit was sucked up by tankers if there were problems with the plant and that the grit was then spread on the West side hardstanding to dry out before placing it in skips and removing it. He accepted that it was malodorous but said that it was not left for days and days. Thames Water also refer to the fact that Mr Peirson accepted in cross examination that occasional drying of grit on the West side, due to problems with the Archimedes screw on the East side, would not necessarily constitute negligence. However Mr Peirson criticised Thames Water for still carrying out this odorous activity at Mogden STW despite all the concerns about odour. He say this practice is unacceptable given the sensitivity of the works to odour emissions and is totally at odds with the investment which has been made to cover and enclose grit collection and handling facilities over the last few years.

177. The evidence of Thames Water's response to the inspection report of 18 July 2008 was that using the hard standings to de-water grit was a standard procedure. Mr Williams' evidence on this was unsatisfactory. At first he denied that the grit was taken outside and spread on the concrete to dry in the sun but he then indicated that it was because of a malfunction of equipment. In the end he seemed to suggest that this was a standard practice for dewatering the grit from the screenings.

178. On the evidence Thames Water did, on a significant number of occasions, carry out drying of grit by placing grit on the hard standing on the West side works to dry out. It seems that when screening plant was defective on the West or East side and at other times a tanker is used to remove grit and that the grit also includes raw sewage. The practice appears to be to discharge the grit and raw sewage onto a hardstanding so that the grit dries before being placed in skips. This seems to be an uncontrolled process which has occurred on a significant number of occasions. I do not consider that dealing with and drying grit in this way as part of the routine operation of the plant when there are equipment defects is consistent with the actions of a reasonably competent operator. I consider that this amounts to a failure to conduct operations at Mogden STW with all reasonable regard and care for the interests of others and that it has caused significant odour emissions.

Storm Water Systems

179. These allegations concern two aspects of the storm water operations at Mogden STW. The first is the storm overflow weir and the second is the storm water tanks.

Storm overflow weir

180. The complaint about the storm overflow weir relates to the frequency of use of the Storm Water Tanks. Essentially the Claimants say that those tanks were used when the Flow to Full Treatment was less than the 810Ml/d design parameter and less than the 695Ml/d which was the reduced operating capacity of the Mogden STW.

181. The Claimants rely on a number of reasons why the storm overflow weirs permitted incoming flow to be diverted to the Storm Water Tanks when they contend that the flows did not justify that action. They allege that those unnecessary flow diversions were caused by negligent design failures by Thames Water and that these led to odour from the Storm Water Tanks.

182. The Claimants also complain about the way in which those tanks were operated. The Claimants allege that the way in which Thames Waters emptied the tanks was inefficient and that they failed to minimise the number of tanks in use. They also say that there was ineffective cleaning of the tanks generally and the hopper areas, in particular. These aspects are all alleged to be negligent failings by Thames Water which led to odour from the Storm Water Tanks.

183. As a result, the Claimants contend that the Storm Water Tanks should have been covered to avoid the odour nuisance.

184. I first deal with the allegations concerned with unnecessary diversion of flows to the Storm Water Tanks and the question of negligent design by Thames Water.

185. The allegations are contained in Particulars of Negligence 20A where the Claimants plead, in summary, that Thames Water unreasonably caused or permitted untreated flows to be diverted to the storm water tanks, by:

(1) Designing the UWWTD works in such a way that Thames Water would be compelled to divert foreseeable flows to storm tanks other than in storm conditions;
(2) Failing to maintain the aeration system and Final Settlement Tank scrapers such that Thames Water was compelled to divert foreseeable flows to storm tanks other than in storm conditions;
(3) Failing to apply chemical dosing to assist settlement in the Primary Settlement Tanks and Final Settlement Tanks so that Thames Water were compelled to divert foreseeable flows to storm tanks other than in storm conditions;
(4) Failing to fill the storm tanks sequentially on the “first flush” principle; and
(5) Failing to carry out capital works including the conversion of the East side PSTs to Final Settlement Tanks prior to 2007.

Design of the UWWTD works

186. In his main expert report Mr Hibberd made six criticisms of the design of the works carried out as part of the UWWTD works for which funding had been made available under AMP2.

187. By the time of his third supplemental report the number of criticisms had been reduced and the basis of criticism on some aspects had changed. I deal first with the criticism of the Biological Oxygen Demand (BOD) loading design figure of 108,000kg/day used by Thames Water in their analysis.

Biological Oxygen Demand

188. There are a number of ways of estimating the BOD loading for the incoming sewage stream at sewage treatment works. One way is to estimate the population equivalent (PE) and then use a figure in kg/day for the BOD loading for that population equivalent to obtain the overall BOD loading. Thames Water used a population equivalent calculation which is set out on a "SOLAR" summary sheet updated on 18 November 1997. That showed an overall PE of 1,660,000 in 1996 increasing to 1,684,339 by 2011 and remaining at that level until 2016. It is stated that the population growth was based on 1996 demographic projections which only went to 2011. Using a figure of 60g per head per day BOD with a PE of 1,660,000 gives an overall BOD of 99,600kg/day.

189. The SOLAR form also set out derived PEs from the BOD and Ammonia data. This gave PEs of 1,927,900 and 1,304,714 respectively, with an average derived PE of 1,616,307. The form also shows an average flow at Mogden STW of 448Ml/d.

190. Dr Koodie gave evidence of the way in which the figure of 108,000kg/day used by Thames Water in their calculation had been arrived at. He recalled that the Mogden STW design load was based on approximately 100,000kg/day and that allowances were made for Heathrow Terminal 5 and the Kew Transfer which brought the figure to 105,700kg/day. He said that this led to a decision to take the figure of 108,000kg/day. He recalled that the historic concentration of Mogden STW's crude sewage was 200mg/l and that this was sampled downstream of the sludge returned liquors. With a design average flow of 525Ml/day this would give 105,000kg/day whilst the figure of 108,000kg/day was used.

191. Mr Hibberd has made a number of criticisms of Thames Water's use of the figure of 108,000kg/day. He considers that a figure of 120,000kg/day should have been used. At one stage he criticised Thames Water for making no allowance for the flows from the recycled flows. He now accepts that the 1997 SOLAR was likely to have been based on loads which included the recycled loads from the West and East sides of Mogden STW so that there was no need to add any figure to the BOD loading to allow for this.

192. His analysis is now based essentially on two aspects. First, he says that when the BOD and ammonia loads used to calculate the average population equivalent (PE) of 1.66m are re-analysed, on the basis of data available at the time of the 1997 SOLAR, the PE figure should have been 1.8m. He refers to exhibit RM4 to Mr Roger Matthews' witness statement and uses the average BOD and ammonia loads for the East side and West side works to obtain a weighted average which is based on 3:1 East:West division to reflect the larger flow to the East side of the works before the UWWTD extension. He also uses an average flow of 490Ml/day to correct for data showing that this was a dry period and the fact that the Flow to Full Treatment value was 540Ml/day prior to the UWWTD extension. On this basis compared to the SOLAR figures of PE of 1.9m based on BOD and 1.3m based on ammonia, his figures are 1.815m and 1.701m. On this basis he says that the PE which Thames Water should have used was 1.8m instead of 1.66m. At 60g BOD per head per day he says that the additional PE of 0.14m would give an additional 8,400kg BOD per day which is some 8% more.

193. The second aspect concerns population growth. Using the PE of 1.8m and allowing for a 95,000 PE increase from the Heathrow Terminal 5 and Kew Transfer new connections and a population growth for the AMP2 period of 100,000 as assessed in the AMP4/5 Scheme, Mr Hibberd calculates a PE of 2.0m. At 60g per head per day this gives a BOD figure of 120,000 kg/day.

194. Thames Water say that Mr Hibberd's criticism of the 1997 SOLAR is unfounded. First they point out that using a PE of 1.8m and a BOD loading of 60g per head per day gives a total BOD figure of 108,000 kg/day which, as Mr Koodie explained, was the figure which the Thames Water project team used. In relation to the population growth, Thames Water say that this is based on hindsight because Mr Hibberd has adopted the later population projections to 2016 used in the AMP4/5 design, not the very modest rise of 24,000 in PE to 2016 as shown on the SOLAR form. They say that Mr Hibberd has no basis for criticising the demographic projections used and that Mr Ratcliff found nothing surprising in a "flat" population projection being adopted in the AMP 2 scheme because, as he said on Day 15, this accorded with his recollection of similar decisions about populations being taken by United Utilities when he was working on AMP 2 and 3 schemes.

195. As explained by Dr Koodie, Thames Water used a BOD loading of 108,000kg/day in their calculations for the UWWTD scheme in AMP2. As Thames Water now point out, Mr Hibberd has arrived at that figure in the first stage of his analysis. His only basis for increasing that figure to 120,000kg/day is by increasing the population projections made in 1997 to reflect the population projections made much later as part of the AMP4/5 figures. I do not see that this can form any basis for criticism of the figures which were used in 1997. The SOLAR document refers to the basis on which population projections were made and that basis is not criticised as being incorrect at the time it was made. Further, Mr Ratcliff's evidence supports the population growth figures used by Thames Water as being consistent with the approach of others in the industry at the time. I am also conscious that in his third supplemental report Mr Hibberd has changed his previous view that Thames Water should have used a BOD loading of 130,000kg/day and has introduced this new line of approach. I consider that this weakens his evidence on this aspect of the case. It cannot be said that there is any obvious error in the approach taken by Thames Water in adopting 108,000kg/day as the BOD loading and I reject the Claimants' criticism of this aspect.

Stirred Sludge Volume Index

196. The second area of criticism concerns the use by Thames Water of a Stirred Sludge Volume Index ("SSVI") figure of 80ml/g in the design of Mogden STW final settlement tanks. The SSVI is a measure of the settlability of sludge. It indicates the floc characteristics of the activated sludge and is used in the design of the settlement surface area of the final settlement tanks.

197. The experts in their joint statement have stated that they agree that:

> "The FST provision in the UWWTD extension was theoretically capable of treating 810Ml/d based on an SSVI of 80ml/g + 20% safety factor when all the other design assumptions were also met.
> Actual SSVI values have been and continue to be above 80ml/g, although normally the activated sludge settles very well in the laboratory SSVI test."

198. Mr Hibberd says that the final settlement tanks are too small under high flow conditions. He says that a comparison between the design for Mogden STW and published data shows that either the 20% safety margin recommended by WRc in TR11 was not included in the design or that the designers had not selected a realistic SSVI of 100ml/g. He says that whilst the SSVI values at Mogden STW were typically 60 to 80ml/g, there is a wide variability, with data showing figures of 109.2 ml/g on 9 April 1996, 150ml/g in March 1997 and 190.4 ml/g on 5 December 1996. He says that as the proposed UWWTD scheme also changed the waste because of introducing chemically assisted settlement it was extremely unwise to design a scheme for below 100ml/g. He refers to a default value of 120ml/g being used by Yorkshire Water.

199. Mr Ratcliff says that the use of 80ml/g "could be perceived as aggressive" compared to other design standards and states that it is normal to assume a figure of 120ml/g for newly built final settlement tanks. However he says that for extensions to existing sewage treatment works it is normal to assess the performance of the existing works. He refers to the witness statement of Dr Koodie and a memo on 10 July 1996 in which Dr Koodie stated:

> "The SSVI at Mogden generally runs between 40-60ml/g. Therefore designing to 80ml/g would not be considered risky. If we designed the extension on an SSVI of 80ml/g and for whatever reason the SSVI increased to 100ml/g (ie as a consequence of insufficient air caused by an air blow, shock load etc) the maximum flow to the FSTs will be reduced as indicated in Table 2.
> ...
> The number of additional FSTs is identical for both the Conventional extension and the Chemical Dosing options. In the case of the nitrifying plant no additional FSTs are required unless we design for an extension of 450 TCMD and using an SSVI of 120ml/g, in which case 3 FSTs are required."

200. Dr Koodie says that SSVI values of about 100ml/g to 120ml/g would be considered standard practice for use when designing a new sewage works and that he was surprised when he found out that the extension works were to be designed for 80ml/g. He says that in the light of operational records showing that the SSVI at the Works ran at between 40 and 60 ml/g he and the project team were confident that designing to 80ml/g was reasonable and would give a safety margin of at least 20ml/g.

201. Dr Koodie explained in his evidence that the conclusion that the sludge at Mogden STW had excellent settlability characteristics went back to 1990 and an original report written by Binnie and Partners. He said that when he arrived in 1995 he was told of the excellent settlability and had looked at the records which confirmed that. His view was that the

excellent settlability was because of the aeration plant. Mr Ratcliff says that, in his opinion, the influent characteristics and the design of the activated sludge process promote an activated sludge with excellent settlability characteristics and that, as the extension (Battery D) replicated the design aspects of Batteries A to C, there was no reason to increase the design SSVI for the extension.

202. Mr Hibberd has considered the data produced by Mr Ratcliff in figure 6 of his first supplemental report and concludes that as the sludge was retained in the primary settlement tanks for a longer period, there was an increasing trend in the value of SSVI and that for the period of December 1995 to December 1996 the data shows that at the East side (A and B Batteries) an SSVI value of 80ml/g was exceeded on 19% of the time and an SSVI value of 100ml/g was exceeded for 4% of the time. The figures for the West side (Battery C) show values in excess of 80 and 100ml/g 5% and 2% of the time, respectively. He concludes that the use of a design value of 80ml/g did not match the operational data at the time.

203. The Claimants therefore say that, on the basis of Mr Hibberd's evidence, Thames Water were negligent in adopting a figure of 80ml/g instead of 100ml/g. Thames Water say that Dr Koodie and the project team responsible for the UWWTD were not negligent when they selected an SSVI value of 80ml/g with a significant safety factor over and above the general running value of 40 to 60ml/g.

204. It can be seen from the memo of 10 July 1996 that Dr Koodie was comparing the number of additional final settlement tanks which were necessary if values of SSVI were assumed at 80, 100 and 120 ml/g. He considered the possible impact of an increase to 100ml/g if the design value was 80ml/g used. The underlying assumption, which he said was confirmed from the records, was that the SSVI at Mogden was generally between 40 and 60ml/g. I have come to the conclusion that Dr Koodie and the design team were justified in approaching the design of the extension on the basis of the data which they had of the settlability of sludge on the existing works.

205. The data which exists shows that the sludge retention in the primary settlement tanks has contributed to the rise in SSVI values but that, at the time in 1995 and 1996, a parameter based on 80ml/g was reasonably considered to have a satisfactory safety margin to allow the final settlement tanks to be designed on that basis. As a result, I do not consider that Thames Water were negligent in adopting an SSVI design value of 80ml/g for the sludge settlability characteristics, particularly at the West side of the works, at that time.

Other criticisms of the UWWTD design

206. There were originally other criticisms of Thames Water's design of the UWWTD work. First Mr Hibberd criticised Thames Water for not making an allowance in the design for the loads in the recycled flows from sludge treatment. In his third supplemental report he accepted that the original flow and load calculations included allowances for recycled loads to the extent that they were used to establish the 1997 loads at Mogden STW. He therefore accepted that it was incorrect to add a further 10,000 kg per day to the revised

design load to include recycled liquors so this led to his corrected BOD design load of 120,000 kg/day.

207. Secondly, Mr Hibberd originally considered that the performance of the primary settlement tanks, expressed in terms of the percentage BOD load removed for average flow condition, was well above that expected for well designed and operated primary settlement tanks. In his supplemental report, having seen exhibit AK1 to Mr Koodie's Witness Statement, Mr Hibberd noted that Mr Koodie had assumed 35% BOD removal for the West side works and 40% BOD removal from the East side. He considered that these values were much more realistic than the 45% BOD removal values which he had been advised had been used in the process design for the average flow condition.

208. Thirdly, based on a BOD load of 120,000 kg/day and taking account of the reduced percentage BOD load removed, Mr Hibberd made a further criticism which is that the sludge loading rates adopted in the UWWTD design were too high for reliable nitrification by the process of oxidation of ammonia to nitrate. Mr Hibberd pointed out that nitrification was essential to achieve the Environment Agency and Tideway Discharge Requirements at Mogden STW. Based on 108,000 kg/day Mr Koodie calculated that with BOD removal rates of 35% for the West side works and 40 % for the East side works the food to mass ratio would be 1.2. Mr Hibberd calculated that the actual figure was 1.24 but in his evidence on Day 14 he accepted that a figure of 1.24 was "right at the very limit" for reliable nitrification to take place. Given my finding as to the appropriateness of a BOD figure of 108,000 kg/day I do not consider that there is anything that can be criticised in the food to mass ratio derived by Dr Koodie. On this basis I do not see that the food to mass ratio adopted by Thames Water forms the basis a valid criticism by the Claimants.

209. Mr Hibberd makes further criticisms by saying that the UWWTD works made no allowance for plant operating at below optimum performance. Dr Koodie said that the UWWTD works were designed with a degree of safety factored in. He says that in deriving the ultimate design load and by selecting conservative design parameters based on the historical performance of the works, he believed there was ample tolerance for normal operational issues. He pointed out that if there were issues with the sewage stream then chemical dosing could be initiated earlier. He considered that on the sludge stream there was ample capacity such that only 16 of the 20 digesters were required operationally. He said that it was also assumed that deterioration of assets such as the aeration lane diffusers would be dealt with by capital maintenance as is standard in practice in the water industry.

210. Whilst I accept that, in the event, some of the plant has not operated at optimum performance, I am not satisfied that Mr Hibberd's criticism that the design of the UWWTD works made inadequate allowance for plant operating below optimum performance has been made out.

211. In addition Mr Hibberd criticises Thames Water for making no allowance for the effects of the extra sludge production on an already overstretched sludge handling system. He

says that this resulted in increased recycling from the PFTs and further reduction in the primary settlement tank performance due to the build up of sludge stocks in these tanks. Dr Koodie said that whilst he does not recall what consideration was given to sludge capacity as part of the UWWTD works, he recalls that between 1995 and 1997 the sludge stream capacity was increased by the installation of two gravity belt thickeners to thicken the majority of the surplus activated sludge at Mogden STW. He said that, in addition , under the UWWTD works a centrifuge was installed so that 100% of the surplus activated sludge was thickened without use of the Picket Fence Thickeners.

212. Mr Ratcliff accepts that during the period between 2000 and March 2002 the Mixed Liquor Suspended Solid ("MLSS") in the East and West side Activated Sludge Process batteries was regularly over the design MLSS concentration of 300mg/l and this resulted in the operational SSVI rising above the design SSVI of 80ml/g. He says that the rise in operational MLSS concentration was caused by the backup of sludge in the upstream PSTs and that the storage of large volumes of primary sludge in the PSTs resulted in limited BOD and Suspended Solids removal. He says that this, in turn, resulted in the downstream Activated Sludge Process batteries having to operate with a higher mixed liquor to ensure complete nitrification. He says that once the sludge backlog was cleared from the PSTs through the permanent solution of drum thickeners, Thames Water were able to control the MLSS at or below the design MLSS level.

213. Mr Ratcliff says and I accept that at this point the plant would have been able to treat 810 Ml/d and achieve an acceptable effluent solids performance but this was not possible because in December 2002 the flow to full treatment was limited to 690 Ml/d. Whilst it is therefore correct that there have been problems with the sludge stream, I do not consider that this is something which arose from any failures in the design of the UWWTD works.

214. It follows that, for the reasons set out above, I find that the Claimants have not made out their case that Thames Water's design of the UWWTD works to increase the flow to full treatment to 810 Ml/d was negligent.

Failure to Convert East Side PSTs to FSTs in 2002

215. The Claimants submit that the lowering of the flow to full treatment to 690 ML/d meant that the storm overflow weir had to be operated so that the inlet stream was diverted to the storm water tanks which therefore had a very high rate of use. They submit that Thames Water should have converted the East side PSTs to FSTs in 2002.They refer to the evidence of Mr Hibberd on Day 14 when he indicated that the conversion should have taken place in 2000, the year that the UWWTD works were commissioned.

216. Essentially, Thames Water say that the two-stage primary treatment process, which was an integral part of the UWWTD works, should have led to high removal of BOD. However they refer to Mr Ratcliff's evidence that in 2002 and 2003 OdourNet identified that the East side circular PSTs were a significant source of odour. Thames Water say they then submitted a business case to Ofwat in 2004 and in 2005 Ofwat approved the funding for Project 59HF which was finished in 2008. Part of Project 59HF included the

decommissioning and cleaning of the East Side circular PSTs and they were then converted to FSTs starting in 2007 and this work was completed in 2009.

217. Thames Water say that, as part of a more recent funding approval, the increase in the Flow to Full Treatment to 1064Ml/d is taking place in two stages. First by the project to convert the circular PSTs into FSTs and secondly by a major expansion to the West side works. In those circumstances Thames Water submit that they acted reasonably in relation to the timing of the relevant capital works and cannot be criticised for not converting the East side circular PSTs to FSTs earlier than they have done.

218. The Claimants say that the odour potential of the East side circular PSTs should have been identified prior to 2002 to 2003 and that Thames Water should have known earlier that there were deficiencies after the UWWTD scheme. They say that the work should have been put in place to resolve the problem earlier because two-stage PSTs were bound to cause more odour than a single stage process and converting the PSTs to FSTs increases the flow to full treatment to 790 Ml/d thereby reducing the use of storm tanks.

219. The First OdourNet report dated November 2002 was commissioned because of the Abatement Notice served by LBH which required Thames Water to mitigate odours generated specifically from the storm storage facility. One of the objectives of the study was to identify the most significant contributors to offsite odour annoyance and discuss practical options to reduce those impacts in the longer term. That report concluded, amongst other things, that the overall magnitude of emissions from Mogden STW was substantial due to the size of process operations, the open nature of the treatment process and the ineffective functioning of current odour control systems. It stated that the current capital investment program involving modification to the operation of two storm tanks was likely to result in an 8% reduction in the total odour emissions released from Mogden STW. In relation to the PSTs they recommended that Thames Water should "*optimise the control and management of return liquors to the East side primary tanks from the sludge handling area of the works, and adopt a robust sludge and scum removal scheme with the tanks to ensure effective removal of sludge and prevent occurrence of septic conditions.*"

220. Following the commissioning of OdourNet in August 2002 and the First OdourNet Report in November 2002, Thames Water implemented an improvement program during 2002/2003. They then commissioned OdourNet to carry out a follow up study to evaluate the impact of those improvements. That study was carried out between August and October 2003 and led to the Second OdourNet Report dated November 2003. In that report OdourNet commented that "*The modifications to the sludge route and East side primary tanks suggest that the scum and sludge management in this area has improved. However, it has not been possible to identify any significant improvement of emissions from this area at this time.*" In their overview they found that 46% of the remaining emissions came from the primary treatment operations.

221. OdourNet said that, based on the observations they made during their site visit and despite the modifications which have been made in 2003, the most likely cause of the

elevated emissions from the East side PSTs and SSTs, compared to the West side PSTs was a combination of the presence of residual sludge in the bottom of the SSTs due to ineffective scraping and sludge removal, the load resulting from the return of supernatant liquors from the PFTs and the low residence time in the tanks which maintained sludge in suspension. They indicated ways in which these causes might be reduced. They said that over and above those options further reductions might be achievable by reconfiguring the flows to enable the SSTs and the PSTs to be operated in series as a single-pass settlement system. They said that the viability of this approach would need to be evaluated in more detailed engineering and hydraulic terms so that the degree of odour emission reduction could be assessed. Other than that, the only option, they said, was to cover the tanks and extract the air to odour control units.

222. On this basis I do not consider that Thames Water can be criticised for not converting the East side PSTs to FSTs in 2002. It seems to me that there were various matters which had to be dealt with before that option was considered and in the context of applications for funding, Thames Water applied to Ofwat who approved funding for Project 59HF which included the decommissioning and cleaning of the East Side circular PSTs. That project finished in 2008. In those circumstances I do not consider that Thames Water failed to conduct operations at Mogden STW with all reasonable regard and care for the interests of others in relation to this aspect.

Failure to maintain the Aeration System and FST Scrapers

223. The Claimants contend that Thames Water failed adequately to maintain and repair or replace the blowers, air distribution system and aeration domes and the FST scrapers.

Blowers, air distribution system and aeration domes

224. In relation to the blowers, air distributions system and aeration domes, the Claimants refer to Thames Water's Mogden Odour Study of 21 December 2001 in which there was no reference to this aspect.

225. In the process review of Mogden STW carried out by Thames Water in August 2002, there were a number of recommendations in terms of routine blower maintenance, dome replacement and repair of air main leaks. In the periodic review in 2004 it was reported that the aeration lanes had domes missing, damaged or blocked and there were major air leaks with some pipe repairs being carried out. Again the blowers themselves were said to be in good condition and reliable but "*with all the leaks on the aeration system, all seven blowers are required to be in service which leaves no spare capacity for service or breakdowns.*"

226. In a Thames Water document dated September 2002 seeking project implementation approval for Project 9MJD, consisting of aeration remedial works Phase 1, Thames Water sought approval for the first phase of investment for dealing with deficiencies in the aeration system. It was stated that the aeration system had been identified as a key area for compliance with the ammonia consent of 1 mg/l set by the Tideway Operating Agreement and the ability to achieve the consented Flow to Full Treatment of 810 Ml/d. In that document it was said that the poor efficiency of the aeration process had caused

failure to meet the Tideway ammonia standard and that a continuous and regular breach of the consent had only been avoided by flow diversion to the storm tanks in order to balance peak loads. It stated that the number of blowers in operation during the Tideway period had increased year on year to the stage where all seven blowers were required to operate continuously. The document also stated that the reasons for the increase in air demand year-on-year and the fall off in aeration performance were three fold. First there was deterioration in the condition of the air distribution main, with two very major leaks. Secondly there was a reduction in blower output with a loss of air due to leaks and with reduced efficiency due to the prolonged use without extended maintenance. Thirdly there was a reduction in the oxygen transfer efficiency because the aeration domes were over ten years old against a recommended length of service of about seven years. Domes had been examined and found to be in poor conditions because they were badly blocked.

227. The Claimants refer to the evidence of Mr Cranshaw on Day 4 when he said he did not believe there was a formalised programme for dome replacement although he recalls that, when he was working with Mr Howarth at Mogden STW in 1990 to 1991, there was some dome replacement.

228. Thames Water submit that they acted reasonably in relation to its maintenance of the aeration system. Whilst the diffuser domes were nearing the end of their life-span in 2001-2002 the aeration lanes were being maintained. They say that they carried out a rolling programme of aeration dome replacement between 2003 and 2005 as part of Project 9MJD.

229. Thames Water refer to the evidence of Ms Shelley Thomas who dealt with these matters at paragraphs 39 to 46 of her Witness Statement. In summary she says that whilst the aeration lanes themselves do not cause odours, difficulties experienced with the aeration lanes in 2002 necessitated increased use of the storm tanks which did have the potential to increase odours. As she explained the aeration domes are porous ceramic disks submerged in the aeration lanes. The air blowers force air through these domes creating fine bubbles which help naturally occurring bacteria in the sewage to grow and remove ammonia. She explained that, over time, the aeration domes become blocked by fine sludge particles or they crack and develop holes through normal wear and tear. She also referred to there being leaks in the 1930s air mains.

230. Ms Thomas explained that in order to keep within the Tideway Agreement consent they had to run all seven blowers and, even with this, during May to August 2002 they had to use the storm tanks to store peak daily flows to reduce the pressure on the aeration lanes. She explains that they had to do so because the priority was to comply with the discharge consent. She explained that because of the problems experienced in 2002 Thames Water applied for £8million in funding in September 2002 so as to replace the aeration domes, repair the most serious leaks in the air distribution pipework and install permanent aeration support to allow the aeration lanes to be taken out of service for refurbishment. Some funding was granted and the work was carried out on a phased basis beginning in January 2003 so that by February 2005 all of the 100s of aeration domes had been replaced on all 20 aeration lanes. She said her understanding was that the domes had a

life of over ten years but had deteriorated more quickly and it was only in 2002 that the aeration capacity had any implication on odour through the use of the storm tanks. It was then that substantial investment was made for the necessary replacement works.

231. In relation to the performance of the aeration system it is apparent that it was only during the summer of 2002 that the aeration system came under stress when all seven blower units had to be working continuously to achieve the Tideway standards. I am satisfied that a significant cause of the difficulties at that time was the fact that the aeration domes had become blocked and that the air mains had leaks in them. However I am not satisfied that prior to 2002 Thames Water were aware of the problems in this respect or, if they had been aware, that they should have made the repair and maintenance of those aspects a priority given that until 2002 the system was not fully utilised.

232. Once it became apparent that there were serious defects which required replacement of the domes in the aeration lanes and repair of the air mains, I consider that Thames Water proceeded reasonably and with reasonable diligence with the replacement of the aeration domes and the other works. I therefore do not consider that Thames Water failed to conduct operations at Mogden STW with all reasonable regard and care for the interests of others in this respect in relation to the blowers, air distribution system and aeration domes.

FST scrapers

233. In relation to the FST scrapers the Claimants refer to the process review of August 2002 where in relation to Battery C it is stated that the scrapers on all the tanks in lanes 16, 17 and 18 were not operating when observed in May 2002. They also refer to the Mogden Operational Review in July 2003.

234. Thames Water say that the FST scrapers are difficult to maintain. They rely on the evidence of Mr Crump where he said at paragraph 15 of his Witness Statement that he does not recall the C Battery FST scrapers breaking down very often. He says that the scrapers only existed to prevent sludge crusts building up on the FST walls and weirs and that, if they broke down, this did not cause odour or affect the sewage treatment process or the discharge consent. They were not, therefore a high maintenance priority. He said they were not built with bridges to allow access to the central bearings and scraper mechanisms and that this made them difficult to maintain without taking the FST out of service and erecting scaffolding in the tank. He says that although they tried to float a pontoon bridge this was prohibited on health and safety grounds when someone fell into a FST and they had tried various other methods. Ultimately as part of the project to convert the existing East side PSTs into FSTs he says that the C Battery FSTs were modified to include bridges.

235. Thames Water also rely on the evidence of Mr Fishlock about the difficulties of access. He says that the FSTs functioned well without the scrapers working and there were not any odour issues associated with the FSTs or their scrapers as the sludge in the FSTs was activated sludge which was not odorous.

236. On the basis of the evidence I do not consider that there were major problems with the FST scrapers or that Thames Water failed to conduct operations at Mogden STW with all reasonable regard and care for the interests of others in the way in which the FST scrapers were maintained. The scrapers were obviously not of an ideal design from the point of view of maintenance but Thames Water tried a number of ways of obtaining access to carry out any necessary maintenance, ultimately installing bridges. In any event, the evidence does not indicate that, in so far as there was a failure to maintain the FST scrapers, this would have caused any odour because the FSTs contained non-odorous activated sludge.

Failure to use Chemically assisted Settlement

237. The Claimants allege that Thames Water failed to reduce the excessive use of storm tanks caused by the inadequate capacity of the Flow to Full Treatment at Mogden STW by making appropriate use of chemical dosing to assist settlement in the PSTs and the FSTs. They say that by the use of chemical dosing lower Mixed Liquor Suspended Solids would have been carried over into the aeration units giving lower aeration requirements and faster settlement rates, so that the hydraulic capacity of the works would have been increased. In addition the Claimants say that chemical dosing in the FSTs would have further increased the hydraulic capacity of the works.

238. Thames Water deny this and say that the use of chemical dosing would have exacerbated problems and been counterproductive.

239. Chemically assisted settlement (CAS) is a process by which chemicals are added to sewage which attract negatively charged suspended particles and help the sludge particles to stick together, enabling them to settle faster.

240. In his main report Mr Ratcliff says that in the UWWTD design chemical dosing was only to be used on the West side at flows to full treatment of between 690 and 810Ml/d. He says that during 2001 to 2004 the sludge backlogs within the PSTs on occasions rose to very high levels and this would have resulted in very poor PST performance, in terms of suspended solids and BOD removal rates. His view is that by adding chemicals this would only have exacerbated the problem as chemical dosing would have increased the sludge production and also produced a very thin sludge which was even less amenable to gravity thickening in the PFTs.

241. Mr Hibberd agrees that the UWWTD design only intended chemical dosing to be used on the West side for flows between 690 and 810 Ml/d but says that he has found little evidence that chemical dosing as intended in the design was carried out for an extended period and in particular beyond the first year of operation in 2000. He said there were only two deliveries in March and July 2000 of the relevant polymer used as part of the process of chemical settling and this would have been essential to achieve the 60% solids removal required for the UWWTD scheme to perform satisfactorily at 810 Ml/d. He says that Mr Ratcliff's view confirms the poor sludge handling capacity of Mogden STW between 2002 and 2005 which he says Thames Water failed to recognise in the UWWTD project and in the subsequent sludge treatment scheme 2CKC. He says that if mechanical

thickeners (for example drum thickeners, gravity belt thickeners or centrifuges) had replaced the PFTs by 2000 then extending chemical dosing treatment to assist the PST performance on both the East and West sides would have made up for most of the deficiencies which he considers there were in the UWWTD design. The Claimants also point out that Dr Koodie says that the design of the UWWTD works assumed that, should the works become stressed for whatever reason, or should plant be out of service for maintenance, chemical dosing could be introduced at lower Flow to Full Treatment values to mitigate the impact.

242. It is noted that in paragraph 81B of the Re-Amended Defence Thames Water state that they carried out adequate chemical dosing in order to increase the capacity of the plant. They said that the design/operational philosophy of Mogden STW was to dose chemicals during wet weather, that is at flows to full treatment of between 720 and 810 Ml/d (270 to 360 Ml/d on the West side). They say that they ceased chemical dosing for settlement purposes in or about November 2002 following the reduction of the flow to full treatment to 690 Ml/d because that reduced flow dispensed with the need for chemical dosing.

243. Mr Hibberd considers that the delivery data would show that Thames Water may have stopped chemical treatment earlier. He says that the Flow to Full Treatment problems could have been remedied to a large extent by a more efficient BOD removal in the PSTs. He says that if chemically assisted settlement had been used continuously on both the East side and West side treatment streams to achieve 60% BOD removal, the same nitrification treatment performance could have been achieved in the activated sludge units with a lower mixed liquors concentration of 2400 mg/litre. At this concentration he says that the sludge loading rate would be a safe 0.1kg BOD/kg MLSS/day which would have enabled the FSTs to work without solids loss at a safe SSVI value of 100 ml/g.

244. It is clear that as part of the design of the UWWTD project Thames Water considered that where excessive flows to full treatment of above 690 Ml/d were encountered, they would use chemical dosing of the West side PSTs. It is evident that that this was an inherent part of the design of the plant. Whilst chemical dosing may have had some impact on the gravity thickening of the sludge in the PFTs I do not consider that Thames Water took reasonable steps to mitigate the impact of the high flows to full treatment by carrying out chemically assisted settlement. Thames Water do not rely on evidence of why they did not do so nor do they seek to establish when chemically assisted settlement stopped.

245. All things being equal, it seems to me that chemically assisted settlement in the PSTs would have allowed higher flows to full treatment so that there would have been less flow to the storm water tanks. I consider that Thames Water failed to conduct operations at Mogden STW with all reasonable regard and care for the interests of others in not using chemically assisted settlement in the PSTs.

246. In relation to the chemically assisted settlement in the FSTs, Mr Ratcliff says that using chemicals in activated sludge processes has limited benefits because the use of ferric salts or powdered activated carbon (PAC) increases the MLSS concentrations and so can be counterproductive. Mr Hibberd says that improved mixed liquor settlement velocities can

be obtained by dosing chemicals into the feed to the FSTs and this has been employed at Glasgow STW at Dalmuir using ferric sulphate and a polyelectrolyte, along with chemically assisted primary settlement. Mr Hibberd says that this enables lower SSVI values to be obtained which avoids blanket overflow from the FSTs. He says that this would have enabled higher flows to be treated effectively in both the East and West sides of Mogden STW. He refers to Thames Water's current action in using PAC to improve the settlement properties of the activated sludge in the FSTs. He says this solution could have been used from 2000 to assist the plant to treat the full 810 Ml/d design flow by reducing the use of the storm tanks.

247. Mr Ratcliff accepts that Thames Water is currently dosing using PAC but he says that during the period 2000 to March 2002 Thames Water were struggling to maintain the design MLSS concentration and adding more inert particulates during this period would have been counterproductive as the MLSS would have increased further. He says it should be noted that, since 2005, Modgen STW has operated with separate mechanical thickening of the primary sludge and the surplus activated sludge. He says that the installed centrifuge capacity is more than capable of thickening the surplus activated sludge production and hence Thames Water can maintain the design MLSS concentration of 3000mg/l even when additional inert material is added in the form of PAC.

248. On this basis it seems again that Thames Water have provided no good reason why chemically assisted settlement was not used to overcome the problems which led to the use of the storm water tanks and I consider that they failed to conduct operations at Mogden STW with all reasonable regard and care for the interests of others by not seeking to increase the flow to full treatment by using chemically assisted settlement rather than allowing excess flows to flow to the storm water tanks.

Storm Water Tanks

249. Having dealt above with the allegations that the storm water tanks should not have been used to overcome problems which arose with the ability of Mogden STW to treat the required flow to full treatment, I now deal with a number of aspects of the operation of the storm water tanks.

Storm Water Tank: Emptying

250. The Claimants say that the storm water tanks were not emptied efficiently or so as to minimise the number of tanks in use. They contend that the emptying should have been automated with up-rated pumps in 2000 so as to meet the Environmental Agency consent requirement. They also say that clearer guidance should have been given in the standard operating manual (SOM) and there should have been better control of the pumps throughout the period. They say that the SOM recommendations on sequential filling and emptying were not consistently followed. Thames Water say that the storm tanks were emptied quickly and in sequence by manual operation by the process controllers.

251. Mr Hibberd says that the storm tank emptying system relies on operator judgment and is not automated. He says that it is limited by the pumping rate of the return pumps and requires complex manual adjustment of the valves at Lucifer's Gate and Penstock John.

His view is that plant operators can only use the limited capacity for the difference between the maximum flow capacity and the actual inflow rate available on the East side of the works. He says, that in order to maximise the effectiveness of the storm tank emptying system there should have been a fully automatic pumping system to both the East and West side inlets using variable speed pumps and linked automation of the existing and new penstocks at Lucifer's Gate and Penstock John.

252. Mr Ratcliff accepts that the storm water return system is manually initiated. He says that the operators identify opportunities to return storm water to the East side treatment stream when the flow on the East side reduces below 450 Ml/d. He says that the operators then start the pumps in a particular storm tank, looking to empty those tanks which are filled first and have had the greatest storm water retention. He believes that the storm water cleaning and emptying is in line with other large sewage treatment works in the UK.

253. In the 2007 Site Operating Manual, at section 4.2 *Storm Tank Management*, the process of storm tank emptying is dealt with. It states that when high flows have subsided the contents of the storm tanks are pumped to the East side PSTs. It adds "*Emptying is under manual selection from SCADA by the process controllers, but it is recommended that the "first flush" tanks be emptied first as they will contain the "first foul flush" of the storm*."

254. In July 2001 the Mogden project team investigated various works which could be carried out to reduce the odour generated from the storm tanks. One of those items was automation of storm tank operation. It stated that automation of the storm tanks operation would ensure that storm flows are managed within the tanks and returned at the earliest opportunity. It proposed an initial stage for automation of storm tank control for half of the storm tanks. In the document produced by Mr Kingdon on 17 July 2001 he referred to work by Binnie, Black and Veatch who had been asked to look at a number of issues concerning the storm tanks and future investment. One of those items was automation of storm tank operation and he confirmed his belief that the best benefit would be gained by initially automating half of the storm tanks and also changing the storm return point and adding the scum weir.

255. Mr Kingdon deals with this in his witness statement. He says that his suggestion became the subject of engineering works during the AMP3 period between 2001 and 2003 and then, following an allowance for funding from Ofwat, it became part of a £42 million odour project in the AMP4 period. He stated that in September 2001 Thames Water submitted an internal capital application for £400,000 to carry out some advance works based on the July 2001 Mogden project team recommendations, as Project 997D. He said this application was approved in October 2001 and completed by April 2002 and involved the installation of a storm weir scum board and relocation of the storm return pipe. He said that in October 2001 funding was granted and approval was given in May 2002 for £2.57 million worth of work, Project 50WC. He said that this included the installation of an actuated inlet flow control penstock which allowed Thames Water to balance the flow to the West and East sides of the works, modification to the storm tanks to operate in sequential fill modes so that the first to fill was the first to be emptied and

installation of increased capacity storm return pumps, together with associated control system so that the tanks could be drained more quickly. He said that these works were substantially complete in October 2003.

256. It was evident on the site visit that there was not an automatic storm tank emptying system. The process depends on manual operation by judging whether the inflow to the East side of the works permits the contents of the storm tanks to be added to the East side process stream. On the evidence it is not clear how and when particular tanks have been emptied because the data is not available. In principle I do not see why a manual system could not operate efficiently provided that the operatives are given sufficient guidance as to how to carry out that operation.

257. I do not consider that on the evidence there was inefficient tank emptying. I am not persuaded that the problem of odour caused by the storm tanks was caused by inefficient tank emptying rather than the fact that there was effluent in the storm tanks for long periods of time. I do not consider that with an efficient system, storm tanks could, in general, have been emptied at an earlier stage and therefore have avoided odour problems.

Storm tanks cleaning

258. The Claimants contend that there was ineffective tank cleaning in the period 1990 to 2007. They say that there should have been more rapid tank washing when tanks were emptied throughout this period and that the ineffective tank scrapers which were eventually replaced by Amajets in the period 2002 – 2007 should have been rectified by 2000 at the latest.

259. Thames Water submit that they acted reasonably in relation to the manual cleaning and maintenance operation of the storm tanks scrapers and hoppers having regard to the fact that this was a 1930s sewage treatment works. They further submit that they did not act unreasonably in not installing Amajets prior to 2002 when they then started replacing the scrapers sequentially with Amajets. The Claimants refer to a number of documents including Thames Water's Mogden Process Review of August 2002 in which it was stated that the storm tank scrapers were in need of refurbishment. It also stated that the current method of cleaning the storm tanks used final effluent but did so by back filling from the bottom of the tank. It stated that this method does not clean the benching before the overflow weir which is generally caked in fat and grease and a source of odour.

260. In a report produced by Black and Veatch in December 2002 concerning odour complaints received in November 2002 it was stated that the sludge formation at the bottom of the storm tanks was an "*ongoing problem caused by the pumping out of the tanks*". It stated that the only way to alleviate the problem was to try and achieve the complete removal of the sludge. It stated that the scrapers and isolation valves needed regular maintenance and checks to ensure they were working to their optimum capacity. It mentioned that one method to be introduced was to install jets in the bottom of the tanks to keep the sludge in suspension and allow for removal; it said this was to be introduced in two tanks but the other tanks needed to be reviewed.

261. In a further periodic review, dated 2004 but apparently referring to 2002, it was stated that the scrapers were not very effective and were in the process of being replaced by swing jets in storm tanks 4 and 5 to reduce odour from the works. It also stated that the storm return pumps block and that the storm return pumps for storm tanks 4 and 5 were in the process of being replaced with larger units to reduce the retention time in the storm tanks.

262. In September 2007 in relation to project 59HF it was stated that the project involved covering the most odorous processes and additionally improvements were being made to equipment in some areas not being covered but which can give rise to odours as a result of poor or unreliable equipment performance such as the storm tank cleaning and draining system.

263. In a letter to Thames Water dated 26 September 2007 LBH stated that when a site visit was made on 8 August 2007, a number of storm tanks were part filled and others had part filled sludge hoppers at the time of the site inspection. It was understood that faulty or failed pumps caused some of these residues. It stated that, given the location and scale of the storm tanks and local sensitivity to odours from the storm tanks "*it is extremely disappointing that there are not more robust management and maintenance procedures to ensure that …(b) There are reliable pumps to empty the tanks and hoppers and back-up pumps are readily available to promptly deal with the failures if necessary; (c) tanks are cleaned out after use if the Amajet system fails…*".

264. LBH mentioned a discussion at a meeting on 19 September 2007 and that issues needed to be addressed with regard to cleaning, filling/emptying management of the tanks and pump maintenance/availability. It said that the delivery of a solution to improve hopper cleaning needed to be addressed as a matter of urgency.

265. In relation to the Amajets, the Claimants referred to the Modgen storm tank daily check sheets in which, in the period April to September 2008, it was shown that there were a significant number of faults with the Amajets relating to a number of tanks within that period. Mr Kingdon, in his witness statement, accepted that one of the main problems with the storm tanks was the old cleaning system. He explained that it was a cable and rail system which had cables about 1 foot above the floor of the tanks with a pulley system. Scrapers with rubber bases were dragged along the cables by the pulley system with the intention of dragging the sludge which had settled on the bottom of the storm tanks into the storm tank hoppers. However he said that the scrapers would leave a film of sludge on the bottom of the tanks which could become odorous. He said that in order to overcome the limitations of that old technology Thames Water would use fire hoses to ensure that the sludge was kept moving and did not cling to the sides or bottom of the tank as it emptied. He said they would also back fill the tanks with final effluent to rinse them out. His evidence was that towards the end of 2001 or the beginning of 2002 four additional dayworks team members were hired to increase Thames Water's manpower to carry out that task. Similar evidence was given by Mr Fishlock, Mr Williams and Ms Thomas.

266. The question is whether Thames Water failed to conduct operations at Mogden STW with all reasonable regard and care for the interests of others, including the Claimants, in not seeking to replace the scraper system prior to 2002 when Amajets were sequentially installed. Thames Water submit that they acted reasonably in relation to the maintenance and operation of the scrapers having regard the fact that they dated back to the 1930s.

267. The universal view of the Thames Water witnesses was that there were major problems with the scraper system. That must have been evident for some time and would lead to sludge being left on the bottom of the tank. I consider that by the late 1990s Thames Water should have been carrying out the replacement of the scraper system with something like the Amajet system which was later adopted. It is clear that the scraper system was very unreliable and difficult to maintain and was ineffective in cleaning the sludge left behind in the storm tanks, which was a major source of odour. I consider that Thames Water should have instigated a better system of tank cleaning so that an efficient system was in place by about 2000. In failing to do so I consider that Thames Water failed to conduct operations at Mogden STW with all reasonable regard and care for the interests of other persons, including the Claimants.

Storm water tanks hoppers

268. The Claimants contend that Thames Water's cleaning of the hoppers in the storm tanks was ineffective. They say that the pumps used to empty the hoppers lost their prime when trying to drain the tanks and that, although mobile pumps were available to empty the hoppers from 2007, they were unworkable and little used.

269. In the First OdourNet Report in November 2002 OdourNet identified emissions from the residual sludge within the storm tank hoppers as being relatively concentrated and unpleasant in nature, arising from the onset of septic conditions within the sludge left in the tanks. In his report Mr Hibberd explains that the 16 storm tanks each had a set of return pumps but they suffer from priming problems at low water levels in the storm tank. In relation to the vacuum pump which has been used to clear the remaining sludge from the storm tanks, he considers that it is a large and unwieldy item of plant which is totally unsuitable for moving along the length of the storm tanks.

270. At paragraph 49 of her Witness Statement Ms Thomas confirms that it was not possible to remove 100% of the sludge from the hoppers because the pumps started to run dry and would automatically cut off to prevent damage. She said that this meant that a small amount of sludge was left in the hoppers. She also said that because the valves on the sludge pipework were in some cases over 70 years old and were infrequently operated they were stiff and could not be fully closed. She says that, as a result, sludge would gradually seep back into the hoppers and overtime they would fill back up.

271. Again, it appears that Thames Water were well aware of the problems associated with emptying the hoppers from the 1990s. It is evident that the hoppers could not be properly emptied and, as Ms Thomas observed, would fill back up because of defective valves. It

does not appear that this was given any priority by Thames Water and as can be seen from the First OdourNet Report this was a serious cause of odour at the plant.

272. I consider that Thames Water failed to maintain or replace the necessary pumps, pipework and valves to allow proper emptying of the storm tank hoppers and by failing to do so failed to conduct operations at Mogden STW with all reasonable regard and care for the interests of others.

Storm water tanks covering

273. The Claimants say that Thames Water failed to cover the storm tanks to control the odours which were caused by the matters set out above. Whilst tanks 4 and 5 were covered in 2006/2007 they say that the other tanks should have been covered. They refer to the Second OdourNet Report in November 2003 in relation to this aspect.

274. The experts agree that progress has been made in covering some of the odorous parts of Mogden STW since 2005 but they disagree as to whether Thames Water acted unreasonably in not providing covers and odour abatement plant for the storm tanks prior to the AMP4 period. Mr Peirson says that other water companies have retrospectively covered processes and plant which would previously have been left open and he refers to examples by United Utilities and Northumbrian Water which he believes are all projects largely completed prior to the AMP4 funding period. Dr McIntyre disagrees. He says that once the 2002 OdourNet survey had been carried out and identified the relevant contributions of the various process units at Mogden STW, Thames Water followed a measured and appropriate methodology that secured funding from Ofwat for the expenditure to install covers and abatement plant for the storm tanks. He expresses the view that prior to AMP4 Ofwat would not have agreed to a funding mechanism for this purpose.

275. The Claimants say that covering all the storm tanks was estimated at £7.5 million at 2002-2003 prices. They refer to a draft AMP4 position paper produced in November 2007 in which those figures were given.

276. There are essentially two questions. First, whether Thames Water should have been aware of the contributions from the storm tanks prior to the 2002 OdourNet survey which identified the relevant contributions the various process units at Mogden STW. The second question is whether or not prior to AMP4 Thames Water should have carried out the provision of covers to the storm water tanks.

277. Whilst Thames Water identifies the 2002 OdourNet survey as being the appropriate turning point, the Claimants say that the 1990 WRc Report drew attention to odour from the storm tanks. In report UC885 of September 1990 WRc set out as their conclusions that the main odour problems at Mogden STW were associated with digester operations. It added " *Further problems are caused by regular use of the storm tanks for balancing dry weather flow and insufficient cleaning of the tanks after emptying.*" Within the body of the report they said that one or more of the storm tanks was always in operation and those recently emptied contained debris. Whilst the H_2S concentrations were lower than

for the digesters they pointed out that the storm tanks had a high surface area and hence a high emission rate of lower concentrations odour was expected.

278. In their subsequent report UC887 dated October 1990 in which they made recommendations, WRc stated "*East side storm tank use during dry weather flow should be reduced to a minimum and improvements implemented for tank cleaning, removal of solids from tank bases prior to storm water emptying, for example.*"

279. It is quite evident from 1990 Thames Water were aware of the high emissions which were coming from the large area of the storm tanks when they were in use. I therefore do not accept that the First OdourNet Report in 2002 should be used as the start date for Thames Water to have given consideration to dealing with problems for the storm water tanks.

280. However, the question still remains as to whether or not Thames Water should have carried out the covering of storm water tanks prior to AMP4 period. Mr Peirson referred to a number of new plants where cover and treat solutions have been adopted, both for coastal and inland sewage treatment works, such as Thames Water's new Reading STW where construction started in 2001. He refers to Northumbrian Water covering aeration lanes at Newton Aycliffe STW in a scheme completed in 1992. He attached to his report a paper describing that covering work given at a symposium in 1994. It is evident that the covering of the aeration lanes was carried out because it was found in that case that the main source of odour was the activated sludge plant. Mr Peirson also refers to United Utilities' Davyhulme STW. He refers to a case study which says that cover and treat works were completed prior to 2004 and says that one of the early phases of cover and treat was, like Newton Aycliffe, the aeration lanes where ADAS, for whom Mr Peirson works, carried out commissioning tests on the biofilters for those aeration lane covers in August 1998. He also refers to a United Utilities plant at Sandon Docks which was a new plant which was subsequently covered and says that in 2002 when he visited it the cover and treat works seemed to be more or less complete. He refers too to Northumbria Water's cover and treat works at Howden STW which he recalls included the primary settlement tanks prior to around 2002.

281. Mr Peirson also makes reference to Thames Water's statement that Ofwat funding for cover and treat for non sludge related odour sources was only available from 2005 onwards under that AMP4 programme. He said this may have been the case in principle but he points out that other water companies were investing in odour controls prior to 2005 as additions to existing works where there were specific problems. He said he has been unable to discover how the odour improvement works at Davyhulme, Sandon Docks, Newton Aycliffe and Howden were funded but points out that funding was made available and may have been from efficiency savings such as the savings made at Mogden STW after the 1999 UWWTD Scheme was completed.

282. From the data now agreed between the process experts on the average proportion of total tank area generating odour it can be seen that the minimum figure was 40% in 2003 with

the highest figure being 73% in 2009 and the next lowest being 67% in 2000, in the period 2000 to 2009.

283. Whilst I accept that Thames Water were aware of the odour potential from the storm tanks from 1990 I do not consider that they failed to conduct operations at Mogden STW with all reasonable regard and care for the interests of others in failing to carry out cover and treat works prior to doing so for tanks 4 and 5 in 2006 to 2007. It is true that certain processes were covered at existing works as part of improvement works but I consider that this does not indicate that Thames Water should have provided a cover and treat solution for the storm tanks prior to it being considered and funding being sought for the works carried out in 2005 to 2006.

284. Another criticism is made by Mr Peirson in relation to the decision by Thames Water in 2005 to only cover two of the storm tanks, despite the fact that they had received AMP funding to cover all seven tanks. He says that this has resulted in continuing odour nuisance through 2008 and 2009 and that this omission will also result in some level of offsite odour impact or nuisance whenever the storm tanks are used in the future. He considers that by diverting approved investment away from the project to cover storm tanks Thames Water can be criticised in relation to their approach to odour control.

285. On 17 May 2005 Mr Stuart Goodwin of Thames Water wrote to Mr Gordon Allan of Ofwat, following a discussion the following week about changes to the scope of odour mitigation works within the Final Determination by Ofwat for the AMP4 period. They said that following a detailed appraisal and further odour assessments by OdourNet Thames Water now proposed to deliver works which would give 66% odour abatement compared to 49% for the work authorised in the Final Determination. The main change was the addition of work to cover and treated the extracted air from the East side circular PSTs. They said that, in respect of the storm tanks, "we propose to cover the frequently used first fill tanks only, with the remaining tanks, which are used intermittently, operating a clean and flush system (as currently in use) to prevent the build up of sludge and hence odour. In the table it showed that covering all the tanks would achieve 17.3% which was not markedly different from the figures previously predicted for covering all of the tanks.

286. On 26 May 2005 Mr Bill Emery of Ofwat wrote to Mr Goodwin of Thames Water and stated:

> "*We are satisfied with the changes to the odour reduction scheme because you have estimated that the amended proposal will deliver greater odour reduction (66.4%) compared to the currently approved scheme (54.9%) based on your April 2005 survey.*
> *We note that there are no material changes in costs from those we had amended. Therefore we accept your proposal. ...*"

287. On 8 May 2006 following a meeting at the end of 2005 between Mr Allan of Ofwat and Mr Brian Crathorne and others at Thames Water, Mr Jerry Cresswell the Head of

Regulation at Thames Water wrote to Mr Allan setting out revised odour mitigation works which Thames Water proposed to carry out at Mogden STW. This proposed that the works should include the conversion of the East side circular PSTs to FSTs with the existing rectangular SSTs being retained as PSTs which would be covered and the extracted air treated. The revised odour mitigation works again provided for only the "first fill" storm water tanks to be covered and treated.

288. On this basis, I do not consider that Thames Water's decision to change from covering and treating all the storm tanks to limiting it to the two "first fill" tanks can be criticised as being a decision which no reasonably competent operator would make. On the basis of the information set out in those letters, as well as, the underlying OdourNet Reports, I do not consider that Thames Water can be criticised for the decision to change the scope of the work to the storm tanks from that set out in the original Final Determination to the revised scheme. This meant that some of the storm tanks would be left uncovered and placed added importance, as they said in their letter of 17 May 2005, to Thames Water operating a proper clean and flush system to prevent the build up of sludge and hence odour.

Primary settlement tank: maintenance

289. The Claimants claim that the scrapers and scum removal system for the Primary Settlement Tanks were inefficient and that there were blocked pipes. They say that in the period 1990 to 2007 all PSTs except for the circular PSTs on the West side were contributing to odour nuisance and that after 2007 the West side rectangular PSTs was still causing odour emissions. They submit that there was a need for more routine attention and compliance with the Site Operating Manual and for there to be repair and replacement of the defective plant.

290. The Claimants rely upon the evidence of Mr Kingdon in paragraphs 42 to 45 of his witness statement where he said that during his time at Mogden STW the principal maintenance challenges which he faced were connected with the settlement tank scrapers, including the one on the West side rectangular PST and with the settlement tank scum removal plant, especially on the East side PSTs. He said that the bearings and the rubbers for the scrapers on these tanks broke fairly regularly and that this was a "legacy" defect arising from the original design of the scrapers which were not robust enough for the task. He said that they were able to replace the scraper parts quickly as they were available "off the shelf". He described the process for replacing the parts which consisted of taking a tank out of service, pumping the water and sludge to another tank or to the sludge stream and then carrying out the repairs before returning the tank into service. He said that the process was potentially odorous and, although they attempted to keep the tanks functioning, sometimes it took longer than anticipated to replace or repair the scrapers. He said that replacement of the parts was not a solution to the underlying problem with the settlement tanks scrapers.

291. In relation to the scum pumps on the East side PSTs, Mr Kingdon said these were also a problem because they were of an old design and had to pump a difficult substance in an aggressive environment. He said that they replaced the pumps annually to try to reduce

the problems and carried out various engineering solutions to try and improve scum removal from the PSTs.

292. The Claimants also referred to the August 2002 Mogden STW Process Review where it was said that the scum removal pipework on the East side PSTs was blocked frequently and this resulted in the tanks being covered in a thick layer of fat and grease. It also said that the scum pumps were supposed to operate automatically but became blocked and generally had to be operated manually. In addition, it stated that scum removal on the West side suffered from the same handling problems as on the East side.

293. In the report produced in November 2002 under the title "Mogden East side Primary Sedimentation: Investigation of Odour and Flow-to-Treatment Issues" it was stated that the East side PSTs and SSTs had been identified as a significant source of odour on the site. It stated that if the PSTs and FSTs could be kept free of sludge and scum, it was considered that there was a potential reduction in odour emission of 61% compared to that in the OdourNet survey. It also stated that: "*it has been identified that the scum removal in the Eastside PSTs is not very effective. Some remedial work has been identified which should be carried out to prevent a build-up of scum which, in warmer weather, adds to the odour problems.*"

294. The Claimants also refer to a Black and Veatch report dealing with complaints received in November 2002 where they said, in respect of the East side PSTs, that one of the known problems was that the scrapers tended to trip out and that, to alleviate those problems, a better de-sludging regime should be introduced to cut the retention time within the tanks and regular maintenance should be carried out on the scrapers.

295. The 2002 Periodic Review said that the East side PSTs were overloaded, that the "*de-scumming pipework*" became blocked and that there was a lot of scum on the surface. It was stated that the scrapers were poor although only of 1998 vintage. It said that the eight de-sludging pumps were adequate but that the four scum pumps were not adequate. In relation to the scrapers for the West side PSTs it said that they suffered from mechanical failure on the cable-winding mechanism; that the motors burned out; that there was poor maintenance and a very jerky motion.

296. In August 2003, after a review of the plant, Ms Marnie Eccles reported that for the East side PSTs the scum removal was poor, the scrapers failed regularly, large areas of open flowing sewage were present and that the tanks drained down very slowly and were odorous. For the West side PSTs she said that the bridge scrapers on the D stream did not work and were always failing and that there were large areas of open flowing sewage.

297. In his expert report Mr Peirson concludes that the evidence shows that there have been reliability and/or maintenance issues with the plant and that scraper failures resulted in odorous drain down procedures to prepare the plant for repair. He said that there had been repeated observations of scum on the East side PSTs through to 2007 and these would have cause elevated odour emissions. He also said that ineffective or blocked scum removal plant had at least been part of the persistent scum position.

298. Thames Water say that these allegations have to be considered in the context of the underlying 1930s construction of the original works. They refer to the witness statement of Ms Shelley Thomas where she said that wear and tear would occur on the rubbers along the scraper bottoms, on the gearboxes, motors and the bearings necessitating repairs and replacement. She said that the maintenance of the PSTs and SSTs was reviewed in 2000 as part of the Maintenance Implementation Project. She referred to her statement in 2004 in relation to the Abatement Notice and said that Thames Water had carried out improvements to the scrapers on the PSTs to improve de-sludging capability before the Abatement Notice was served.

299. Thames Water submit that they dealt with the problems which arose in relation to the scrapers and scum removal in a reasonable manner. So far as scum was concerned they said that an allowance needed to be made for the age of the works and the significant increase in the number of restaurants in the catchment area. It said that improvements were made during Projects 997D and 50WC. Thames Water stated that the two West side rectangular PSTs treated 17% of the influent flow, the remaining flow being treated by well-functioning PSTs. It said that it acted reasonably in relation to the scrapers although it is now recognised in the UK water industry that bridge scrapers installed in rectangular PSTs are very unreliable. It said that it looked at all scraper options and installed Zickert reciprocating scrapers in the East side rectangular PSTs in 2006 and as part of Project 5X8FD will install new scrapers and cover the West side PSTs.

300. Thames Water referred to the supplemental report of Mr Ratcliff in which at paragraph 35 he acknowledges that the performance of the West side rectangular PSTs has been poor mainly due to reliability issue associated with the bridge scrapers. He said that after the sludge retention issue was resolved by the use of mechanical thickening of the primary sludge in 2003, Thames Water has successfully operated the PSTs treating 83% of the influent flows since 2004. He said that in 2008 Thames Water was faced by a large reduction in PST performance as a result of Project 7HG9 which significantly reduced odour but resulted in a substantial change in the operation of the East side PSTs. He says that records of the BOD removal rates between 2006 and 2009 show that in 2009 the performance of the East side PSTs recovered but performance reduced again because Thames Water were learning how to operate the Zickert reciprocating scrapers. As a result Thames Water has struggled to treat 690 Ml/d during 2009.

301. The evidence shows that from the 1990s the PSTs have suffered from a number of problems because of inadequate scrapers and scum removal plant. The information available shows that from 2002 Thames Water have been gradually carrying out work to improve the scraper systems but that there were real problems with the existing 1930s plant, as modified over the years. There appears to have been no consistent planning to improve the system of scrapers and scum removal until the Zickert reciprocating scrapers were introduced in 2006. Rather, it seems that Thames Water struggled to be able to maintain and operate the existing scraper and scum removal systems on the PSTs and SSTs without success when these were known to be a significant source of odour. I

consider that from the late 1990s Thames Water should have been carrying out modifications to the scraping system for the PSTs/SSTs, but failed to do so.

302. In the circumstances, I consider that Thames Water failed to conduct operations at Mogden STW with all reasonable regard and care for the interests of others in the way in which they approached problems with the scraper plant and scum removal on the East side PSTs and SSTs in the period up to 2007 and in relation to the rectangular PSTs on the West side beyond 2007.

Primary settlement tanks: Sludge Stocks

303. The Claimants contend that between 1990 and 2005 there were problems with all the PSTs except for the circular PSTs in the West side. These problems were caused by excessive sludge stocks which, in turn, were caused by inadequate thickening capacity. They say that this was because of the ineffective PFTs with a mechanical sludge de-watering plant.

304. The Claimants refer to the Experts' joint statement in which Mr Hibberd's view is summarised in the following terms:

> "*The PFT had been shown to be incapable of treating the sludge production at Mogden STW to a thickness required to enable the sludge digesters to work at the correct temperature to stabilise the sludge. Problems with the PFT date back to their commissioning in March 1992.*
> *The main cause of the problems is that PFTs do not work with sludges that are septic and are likely to produce gasses which prevent consolidation.*
> *The MSTW primary sludges are likely to be septic due to the long retention time in the sewerage system and in the PSTs.*
> *Extended retention times in overdesigned PFTs make the problems with gassing more serious. Further, sludge from the co-settlement of primary and activated sludge has long been accepted as unsuitable for treatment by PFTs.*
> *Records of the continuing problems with the PFTs in the late 1990s when most of the co-settlement had ceased should have alerted TWUL to the need to re-engineer this stage of treatment as a matter of urgency.*
> *It not only failed to do this but also failed to appreciate that the additional sludge from the UWWTD scheme and the proposed work on the sludge digesters would put unacceptable loads on an already over-stretched sludge treatment plant.*
> *UWWTD scheme is estimated to have added some 10% additional sludge production due to the additional flows being treated including flows from Kew STW and the use of chemicals to assist primary settlement. This would result in more primary sludge without a corresponding reduction in the amount of secondary sludge.*
> *Drum and belt thickeners and sludge centrifuges were widely available in the late 1990s for this type of duty, but the recognition of the need to abandon the PFTs and move to this type of technology at MSTW occurred only gradually through to 2003.*"

305. Mr Ratcliff's views are somewhat different and are summarised as follows:

> "*The Defendant's approach to sludge consolidation was in line with the rest of the UK water industry.*
> *The initial installation of Picket Fence Thickeners (PFTs) in 1992 was seen as the best technology for thickening co-settled sludges, as defined in the WRc UD 819 document.*
> *It is recognised that the loadings used at MSTW were lower than the recommended loadings defined in the WRc guideline. Although installing 6 PFTs instead of 4 PFTs, in 1992, would not have resolved the issue that PFTs do not operate well when fed with co-settled sludge.*
> *In 1995 the Defendant recognised the performance issues associated with gravity thickening of co-settled sludges, this was in line with other UK water authorities.*
> *1995-1999 the defendant moved (in stages) from gravity thickening of co-settled sludges to primary sludge only. At this point the loadings were well above the WRc required loading rates. In fact once the PFTs were operating on primary sludge then only two of the four tanks should have been required. The secondary sludges were thickened separately by industry best practice gravity belt thickeners and centrifuges.*
> *This arrangement of gravity thickening of primary sludges and mechanical thickening of secondary sludges is seen as best practice approach and also on a global basis.*
> *July 2001, combined with the digester refurbishment, Thames recognised the need for reduced digester volumetric throughput and thus looked to increase the thickened sludge dry solids concentration.*
> *July 2001-April 2002, defendant trial all UK water industry recognised mechanical thickening equipment. Through trial, drum thickeners are selected and first machine installed in April 2002, two more installed in April 2003.The selection of drum thickeners in 2002 was very new to the water industry, but this choice was now reflected across a great deal of sites across the UK*."

306. The Experts agree that in 1995 the PFTs were recognised as not being suitable for the thickening of co-settled sludges. They accept, though, that the PFTs are an accepted process for the thickening of fresh primary sludges. They summarise their disagreement as being a disagreement on the timing of the conversion to full mechanical thickening.

307. Mr Hibberd, at paragraph 403 of his main report says that the bottleneck in the sludge processing system was one of the main causes of the very high levels of odour complaints between 1999 and 2003 because the work on refurbishing the digesters left the remaining digesters incapable of treating the sludge production at the necessary rate and this caused a massive sludge build up in the primary tanks. He considers that the problems with the PFTs should have been identified and alternative sludge de-watering plant made available well before the sludge crisis in 2000 to 2003.

308. The Claimants say that sludge problems were recognised in 1995 when Thames Water reported as follows:

> *"Progressive deterioration of the Mogden digestion process over many years, coupled with increased works loadings and greater sludge make has put pressure on the entire process such that digestion periods and temperatures achieved are insufficient to give complete stabilisation of the sludge…; since installation of centrifuges to accelerate clearance of the site the underlying problem has manifested itself in odour generation.*
> *Recent installation of gravity sludge thickeners has been unsuccessful due to the presence of co-settled surplus sludge - a process constraint now fully recognised. The urgent need is to remove a substantial portion of the SAS from the gravity thickener stream and to provide an effective but temporary alternative to allow evaluation of performance, an immediate improvement in the digester feed sludge thickness and consequent reduction in odour problems.*"

309. As Mr Hibberd says, the PFTs were installed in 1991 to thicken the sludge feed from the primary settlement tanks. He refers to the November 1994 Odour Strategy Report produced by Thames Water in which it is said that the PFTs were commissioned in March 1992 but had since undergone a series of shutdowns to allow further modifications to be carried out. It stated that the project team had recently completed pipework modifications in an effort to improve the performance of the thickeners, effectively by reducing the age of the sludge that enters them. It was reported that this had minimised the backlog of sludge in the primary tanks and hence any odour associated with it.

310. The Claimants refer to Mr Crump's witness statement where he said that by 1995 it was understood that co-settling was causing the PSTs to underperform. He said that at that time the PFTs had been installed at great expense and were still relatively new and that if Thames Water were to move away to an alternative use of technology that technology would have to be carefully trialled before further long-term investment was made. He recalled a series of meetings during 1995 and referred to a meeting on the 22 May 1995 when a trial to divert half of the surplus activated sludge away from the PFTs to a belt thickener was discussed. He said that this trial was carried out under project 19HB which was approved in July 1995. He said he recalls that the trial was conducted with a belt thickener provided by the manufacturer, Simon Hartley, and was very positive. He said that the installation of a permanent gravity belt was sanctioned, however there was a long lead time and when the temporary belt thickener was removed the sludge stream deteriorated.

311. Mr Crump referred to a memo dated 1 November 1995 in which an emergency solution was sought pending the completion of Project 19HB around February or March 1996. The proposed solution was to bring a belt thickener to Mogden STW which was intended for one of Thames Water's other sites. He said that this plant was temporarily installed in December 1995 and the permanent installation was completed in March 1996. He said that the intention was to remove a proportion of the surplus activated sludge (SAS) to allow Thames Water to evaluate the performance of the sludge stream using both the PFTs and a belt thickener before committing to further investment. He said that in

February 1997 Thames Water installed a second belt thickener to increase SAS thickening capacity to 67%.

312. Mr Crump stated that removing progressively more of the SAS from the flows to the PFTs had a positive effect upon their performance and therefore on the operation of the sludge stream at Mogden STW. However PFT performance remained unstable throughout the late 1990s. He said that in 1998 to 1999 Ms Tracy Williams of Thames Water led a review of the Mogden sludge stream which reported in November 1998, with recommendations in December 1998 and January 1999. He said that whilst some improvement was made to the PFTs, the performance of the PFTs again deteriorated when the weather warmed up in the summer of 1998 and 1999. He said that the recommendations made as a result of the review were implemented either by Mogden's operations team during 1999 and 2000 or by way of the digester refurbishment project (Project 2CKC), carried out between 1999 and 2002. He said that, as recommended, additional SAS consolidation capacity was installed in May to June 1999 and that, as part of the digester refurbishment works, the PFTs were refurbished.

313. Despite making operational improvements to the PFTs during the 1990s, Mr Crump said that they continued to be problematic and the investigations in 1998 concluded that PFT performance would be robust only if SAS could be completely diverted from the PFTs. In those circumstances in December 1998 a locally identified need was raised for funding of up to £400,000 for additional SAS thickening capacity to eliminate flow of SAS to the PFTs during normal operation and to provide some further capacity in the SAS thickening plant. The proposal was to install two additional gravity belt thickeners to take the SAS thickening capacity to 100%. As a result, he said that in February 1999 Thames Water recommended the relocation of the SAS centrifuge from Maple Lodge at a cost of about £110,000. This centrifuge was installed in May/June 1999 and did take Mogden's SAS thickening capacity to 100%.

314. Mr Crump said that the problems experienced with co-settling in 1996 to 1997 affected Thames Water's ability to keep the liquor levels at around 2500-2700 mg/l necessary to keep the SSVI level below 100ml/g. He said that this had an impact on how hard Mogden STW had to operate to achieve the discharge consents and that following the commissioning of the SAS centrifuge there was an immediate positive effect on Mogden's sludge stream, with the amount of sludge held in the works in 1999 and early 2000 generally much lower than it had been. However he said that the gravity belts presented a particular problem because the belts would bind and wear out, requiring maintenance. This meant that the belts had to be taken out of service for a short period which caused some spill-over of the SAS into the PSTs where it was co-settled and sent to the PFTs.

315. The Claimants particularly rely on Mr Kingdon's July 2001 report where he said:

> "*There is no doubt that the Achilles heel of Mogden is the PFTs which were installed in approx. 1996, initial design calcs showed 6 were needed but the decision was taken at the time to try and push the process to utilise 4 only. Hence*

> *the process when co-settling is hopelessly overloaded and can't generally cope with the throughput rates required. This has a knock on effect of creating a backlog of sludge in the works which especially the Secondary Settlement Tanks (SSTs) causes a proliferation of odour as it gradually turns septic waiting to be removed from the tanks. This is particularly prevalent on the East side of the works.*"

316. Mr Crump also referred to the impact of the digester refurbishment project, Project 2CKC. Because of the need to meet new regulations for the disposal of sludge to agriculture Thames Water then embarked on Project 2CKC to improve the heating of sludge in the digesters. The project commenced in 1999 and lasted until 2002. It involved, amongst other elements, the progressive decommissioning, refurbishment and decommissioning of the digesters. Mr Crump said that the work being carried out did temporarily reduce the capacity of the digesting process to accept thickened sludge and also reduced the flexibility of the operating sludge stream. He says that, despite planning the digester refurbishment project so as to stagger the decommissioning of the digesters, the reduction in the number of operational digesters at any one time did result in a temporarily reduced capacity to process sludge. He referred to problems which were encountered in carrying out the digester refurbishment project. It was necessary to move large amounts of asbestos cladding which covered the hot water pipes feeding into the digesters and there were problems of gas escaping from the digesters in the form of methane and H_2S which had an impact on the project.

317. Mr Crump said that the effect of the delay in the digester refurbishment project was a build up of sludge in the thickening plant and in the PSTs where it risked turning septic and generating odours. He said that in July 2000 he wrote to local residents to explain the position and the odour was mitigated by dosing the inflowing sludge with ferric chloride so as to bind sulphides in the sewage so they could not form an odorous gas.

318. Mr Ratcliff says the digester refurbishment project restricted the sludge volumetric throughput by 25%. He says that Thames Water calculated that, with the combined performance of the SAS mechanical thickening and the primary sludge gravity thickening, the digester retention would be 15.5 days based on a thickened sludge concentration of 4.5% dry solids. On this basis Thames Water released a bank of four digesters at a time for refurbishment. Mr Ratcliff has plotted the sludge retention across the PSTs and is of the view that, due to unexpected restrictions in the digester throughput caused by the refurbishment, the sludge built up in the PSTs resulting in long sludge retention in the period between 2001 and 2004. He says that the main issue of long sludge retention is that the dissolved oxygen is used up by bacterial action and the sludge becomes anaerobic and therefore less amenable to gravity settlement. This, he says, in turn, results in the reduction of the PFTs' performance by producing thinner sludges.

319. Mr Ratcliff says that, because of the digester refurbishment, in July 2001 Thames Water recognised the need to reduce the digester feed flow rate and thus looked to increase the percentage dry solid concentration of the feed sludge. He says that between July 2001 and April 2002 Thames Water carried out trials of all of the different types of recognised

mechanical thickening equipment in the UK water industry. After these trials, drum thickeners were selected as the preferred technology for mechanical thickening and in April 2002 the first machine was installed, followed by two more drum thickeners in April 2003. He says that later in 2005 Thames installed a further three drum thickeners and at this point all primary sludge was mechanically thickened by drum thickeners.

320. Mr Hibberd concludes that Thames Water failed to provide adequate sludge consolidation and treatment capacity before about 2003 which led to high levels of sludge storage in the PSTs and increased odour emissions. Essentially what he says is that problems with the PFTs should have been identified and alternative sludge dewatering plant made available well before the sludge crisis in 2000 to 2003. He says that proper risk analysis in relation to Project 2CKC would have identified the probability of inadequate sludge handling capacity. In essence what he says is the measures subsequently adopted between 2002 and 2006 to install adequate sludge handling capacity for both the primary and secondary sludges should have been taken at least 5 years earlier.

321. In response Thames Water submit that that there is no cogent evidence that they acted unreasonably in relation to the sludge process problem. Rather they submit that they took all reasonable steps to remedy the problem once they became aware of it. They say that in 1989 to 1991, when the decision was made to install PFTs, that decision was entirely reasonable. They rely on Mr Ratcliff's view at paragraph 104 of his main report where he says that the original decision to use PFTs was sensible as the alternative of using centrifuges was relatively unproven at that time, especially for the process of thickening. He says that Thames Water's approach to sludge consolidation was in line with the rest of the UK Water Industry. He also says that the initial installation of PFTs in 1992 was seen as the best technology for thickening co-settled sludges, as defined in the WRc UD819 document.

322. Thames Water say that the PFTs were intended to improve the sludge thickening process but unfortunately and unknown to Thames Water at the time of their installation in 1992, PFTs had difficulty dealing with co-settled sludge. Thames Water say that they made every attempt to optimise the PFTs and to reduce the sludge backlogs. They say that a process of optimisation for the PFTs was acceptable and rely on Mr Hibberd's acceptance of that principle in cross-examination on day 14. Thames Water rely on Mr Cranshaw's witness statement at paragraph 47 where he says that between 1992 and about 1995 he spent a considerable amount of time trying to optimise the performance of the PFTs so as to maintain sufficient performance to prevent sludge backing up in the PSTs.

323. Thames Water say that it is a question of judgment as to when the time came to move away from PFTs. They say that Mr Hibberd's view that the time to move away was 1995 is illogical as Thames Water, in common with other parts of the industry, were just discovering in mid to late 1990s that the PFTs had difficulty working with co-settled sludge.

324. Thames Water say that in 1995 Thames Water recognised performance issues associated with gravity thickening of co-settled sludge as did other UK Water companies. They rely on Mr Ratcliff's evidence that Thames Water's efforts to tackle the sludge stream were not merely reasonable and pragmatic but based on best practical means. The conversion of the PFTs from operating on co-settled sludge to primary sludge was carried out in three stages, thus allowing the improvements to be assessed for each stage. He says that it was understandable that Thames Water were cautious in their approach and did not want to abandon the PFTs without trying to make them work. He says that the arrangement of gravity thickening of primary sludge and mechanical thickening of secondary sludge is the best practice approach for sewage works in the UK water industry and globally. He refers to sites which still operate with PFTs thickening of primary sludge.

325. In relation to drum thickeners he says that these were initially used by the UK water industry during the late 1990s, typically to thicken SAS. He refers to a number of water companies which installed them but says that the early machines in the late 1990s were small and only really suitable for small sites. He says that by the early 2000s drum thickeners began to become more established in the market as a competitive technology for mechanical thickening for both primary sludge and SAS. He says that drum thickeners are now seen as the most cost effective solution for primary sludge mechanical thickening.

326. Mr Ratcliff says that the replacement of the PFTs by drum thickeners at Mogden STW took from February 2002 to spring to summer 2005. He accepts that from March 2001 to the start of 2004 the sludge build-up in the PSTs was very high for intermittent periods.

327. Thames Water submit, relying on this evidence from Mr Ratcliff, that what they did was a perfectly sensible approach by moving in stages away from co-settlement tanks and to consider whether the PFTs were capable of functioning properly after each stage. They say that Mr Hibberd's criticism is really that the process took too long. They also say that Mr Crump's view was that the PFTs were vulnerable to large quantities of rag which were going to be removed when project screens were installed under the new UWWTD project in late 1998 and early 1999.

328. Thames Water say that the diversion of the SAS away from the PFTs by 1999 solved the problem of sludge backlogs caused by the inability of the PFTs to deal with co-settled sludge. However in the late 1990s because of the requirement to improve the quality of sludge to make it acceptable to farmers and food retailers as a result of the British Retail Consortium's *"Hazard Analysis and Critical Control Point"* document and also the Sludge Use in Agriculture Regulations 2002, Thames Water had to refurbish 16 of the 20 digesters in order to reduce the number of potential pathogens in the digested sludge and comply with these new requirements. They state that this work, carried out under Project 2CKC, involved decommissioning of a number of digesters at any one time and, in order to minimise disruption, Thames Water calculated that the best practical solution was to release a bank of four digesters at a time, as explained by Mr Glass at paragraph 21 of his witness statement, based on the calculation provided by Mr Matthews.

329. Mr Glass says that in 1999 the Thames Water team carried out a calculation to check the process design to ensure that removing four digesters from service would not affect the ability to process sludge for the required minimum 12 days. He refers to the design check which cannot be found but which has been re-created by Mr Mathews, the digester projects process engineer who had carried out the original calculation in 1999. He says that, as can be seen, with four digesters out of service and an assumed effective digester volume of 80% there would remain enough digester capacity to process Mogden's average daily sludge make of 2553m^3 and still retain sludge in the digesters for 20.6 days, well above the 12 day minimum. In the worst case, with four extra digesters out of service, he says that the calculation showed that Mogden would still be able to achieve 12 days retention time in the remaining 12 operational digesters.

330. Thames Water accept that this meant that there was less digestion capacity and that as the project evolved and took longer than predicted, there was a sludge backlog in the PSTs and that this meant that the retained sludge in the PSTs sometimes became septic and caused odour. They say that they tried to remedy this problem by bringing refurbished digesters back on line as quickly as possible and by dosing with ferric chloride.

331. Thames Water say that they made every effort to improve sludge consolidation and between July 2001 and April 2002 carried out trials of all the different types of recognised mechanical thickening equipment, with the first drum thickener being installed in February 2002 and two further drum thickeners in April 2003 by which time the sludge backlog had been cleared. They say that the PFTs were then phased out between 2003 and 2004.

332. In summary, Thames Water submit that they acted entirely reasonably in relation to the sludge thickening problem. They say that the Claimants' submissions that, in effect, they should have abandoned the original investment in PFTs at an earlier stage is unrealistic and the Claimants have made insufficient allowance for the reasonable practicalities of the situation. They say that it was only in retrospect that it emerged that drum thickeners were the answer to the Mogden STW sludge thickening problem. They refer to the evidence of Ms Thomas when she recalls that she and Mr Kingdon crossed their fingers when the first drum thickener arrived on site in 2001 because the manufacturers would not guarantee performance with the variability of sludges seen at Mogden STW.

333. There clearly can be no criticism of Thames Water for installing the PFTs in 1989 to 1991. At that time PFTs were considered to be the appropriate piece of plant and indeed they have continued to be used in the UK water industry and globally since that date. There is no doubt, though, that they had performance difficulties at Mogden STW soon after they were commissioned. I do not consider that Thames Water can be criticised for attempting to deal with those matters and to optimise the performance of the PFTs as they did in the period between 1992 and 1995. It was then in 1995 that it became clear to Thames Water that the PFTs were not going to work with a high SAS content in the co-settled sludge. They were therefore faced with having to find another way of thickening the co-settled sludge.

334. There was nothing unreasonable in the approach which Thames Water then took in October 1995 of diverting 45% of the SAS away from the PFTs and using a gravity belt thickener to thicken that proportion of the co-settled sludge. That percentage reduction in the amount of co-settled sludge passing to the PFTs was not found to be enough and in 1997 Thames Water then increased the proportion of co-settled sludge diverted away from the PFTs to 75% by installing a further belt thickener. Again I do not consider that this approach was unreasonable. The final diversion then took place in May 1999 when all of the co-settled sludge was diverted away and this was done using a centrifuge which was diverted from another Thames Water site.

335. Whilst it took nearly four years to reach the 100% diversion I do not consider that Thames Water can be criticised in this respect. Of course, with the benefit of hindsight, it can be suggested that Thames Water might have diverted 100% of the co-settled sludge away from the PFTs in 1995. That however is not the correct approach and I consider that, on the evidence, Thames Water acted reasonably in achieving appropriate performance, as they did by May 1999, with the PFTs acting on the primary sludge and with the combination of belt thickeners and centrifuges acting on the SAS.

336. On the evidence it seems that if there had not been the need to improve the sludge digestion process to comply with new requirements and regulations, the process changes which had taken place up to 1999 would have left a satisfactory sludge stream without a backlog in the PSTs.

337. However, with the regulations requiring the removal of pathogens from the sludge process so that the sludge could be used in agriculture fertiliser, it was necessary for Thames Water to undertake Project 2CKC which involved, amongst other things, the refurbishment of the digesters. This required a number of digesters to be taken out of service. As Mr Glass has explained in his witness statement, calculations were carried out at the time by Mr Mathews, the Process Engineer for that project, in order to assess the optimal number of digesters to be taken out of service at any one time. This was necessary so that the period which the works would take could be balanced against the need to maintain the sludge stream in the state it was in 1999.

338. Whilst some of those assumptions made in that calculation, in hindsight, might be questioned, I do not consider that it can be suggested that the analysis was carried out at the time without reasonable care. The result of that calculation was that four digesters were to be taken out of service at any one time.

339. There can be no doubt, however, that the digester refurbishment project did not go according to plan and problems, which included the discovery of asbestos in the hot water pipes and the need to avoid the effect of explosive and noxious gases, together with various other contingencies, led to the project being delayed and this created the sludge backlog in 2000 to 2003 with its effect upon the odour being generated at Mogden STW.

340. By July 2001 Thames Water had taken steps to reduce the feed flow rate into the digesters by increasing the percentage of dry solid concentration of the feed sludge. I do

not consider that they can be criticised for taking from July 2001 to April 2002 to trial the available mechanical thickening equipment and then deciding to adopt drum thickeners as the preferred technology for mechanical thickening. This led to the first drum thickener being installed in 2002, with further drum thickeners in 2003, when the results with the first had been seen to be satisfactory. This brought the sludge backlog to an end by 2004 and Thames Water then subsequently installed three further drum thickeners so that all primary sludge was thickened in this way.

341. I have carefully considered Mr Hibberd's opinion that all this should have occurred some five years earlier but do not consider that that is a realistic view to take and, in my judgment, it is a view which can only be expressed when it is informed with hindsight. The reality is that Thames Water faced a number of difficulties from the initial installation of the PFTs through to the discovery that PFTs were inappropriate for 100% co-settled sludge. This led, appropriately in my view, to the gradual reduction of co-settled sludge through the use belt thickeners and a centrifuge so that by 1999 the process was satisfactory. Thames Water then had to deal with the new requirements which led to Project 2CKC. It was this project which, in turn, became delayed and this led to the sludge backlog. Thames Water dealt with this by the installation of drum thickeners, eventually installing these for all of the thickening process.

342. In those circumstances I do not consider that the measures subsequently adopted in installing sludge handling capacity from 2001 to 2005 should, as Mr Hibberd believes, have take place some five years earlier. Having reviewed the various criticisms made by the Claimants, I have come to the conclusion that Thames Water did not fail to conduct operations at Mogden STW with all reasonable regard and care for the interests of others in respect of sludge consolidation and treatment capacity at Mogden STW at any stage before they achieved the situation they did in about 2003.

Primary Settlement tanks: Sludge Stocks Temporary Solution

343. The Claimants contend that in the period between 2000 and 2005, because of inadequate sludge thickening capacity during the digester refurbishment all PSTs, except the West side circular PSTs, had excessive sludge stocks and that Thames Water should have hired temporary sludge de-watering plant to reduce those stocks during 2000 if they had not already installed permanent plant.

344. The Claimants rely on Mr Hibberd's evidence in the Experts' Joint Statement that, including the effect of the UWWTD scheme, the sludge production rate at Mogden STW was around 150t dry solids each day. He says that on the basis that the existing plant could deal safely with 120t dry solids per day but the digestion refurbishment scheme took away some 15% of the digestion capacity, the shortfall in capacity was some 50t dry solid per day. He says that this is a measure of the problem facing the plant operators between 2000 and 2004. He says that there appears to be general agreement that there was a large shortfall in sludge handling capacity at this time which was only rectified by the installation of the drum thickeners.

345. He considers that Thames Water should have anticipated this, at the latest during the early design stages of the UWWTD scheme and the digester refurbishment project (2CKC), so that provision could have been made for increased sludge handling plant by 2000. He therefore considers that the de-watering plant should have been upgraded well before 2000. He points out that Thames Water responded to the sludge handling problem in February 2002 by hiring a drum thickener to take some of the sludge from the PFT system. He also refers to what Ms Thomas says in her witness statement that it took a month to install the temporary drum thickener and that they went down the route of hiring one which had the effect that the sludge levels in the works had been reduced to an all time low of $3500m^3$ by October 2002. He says that this shows that short term contingency measures could have been implemented to relieve the sludge crisis in 2000 in a few months and at very reasonable cost.

346. The Claimants also rely on Mr Peirson's response to criticism that temporary sludge thickening plant would give rise to further odour emissions. He says that the consequences of sludge backlog were not preferable to the potential odour emissions which would have been generated by a relatively compact and well organised temporary sludge thickening facility.

347. Thames Water say that this allegation underestimates the costs and operational burden associated with such a project at Mogden STW. They say that a project to provide a temporary solution would have been a massive undertaking and would have involved the installation of seven very large centrifuges running 24 hours a day and a huge increase in skip lorry movements. Moreover they say that such operations could be counter-productive because there was a substantial risk that they would generate more odour than they were trying to avert. Thames Water rely on Mr Ratcliff's support for that view. They point out that Mr Ratcliff also deals with alternatives, such as pumping raw and digested sludge to Perry Oaks, but considers that this would not be an appropriate temporary solution as methane would potentially have formed in the pumping main causing both health and safety and pumping issues. In addition he considers that there would have been difficulties because all of the sludge at Perry Oaks would have had to be limed to produce an acceptable bio-solids product.

348. Mr Ratcliff says that the decision to continue to digest sludge anaerobically at Mogden STW and thus stabilise and remove the odour potential of the sludge prior to offsite de-watering was the most appropriate solution. He says that Thames Water accepted they had to increase the digester sludge dry solids throughput and recognised the limitations in the PFTs. He says that Thames Water properly assessed the most appropriate primary sludge mechanical thickening process by carrying out onsite trials.

349. As I have previously stated, it seems to me that the suggestion that, as originally pleaded, temporary sludge centrifuges, or as now alleged, drum thickeners should have been installed prior to 2000 is an allegation made with the benefit of hindsight. I do not consider that the problem which led to the sludge backlog in 2000 should have been foreseen by Thames Water in the planning stages for the UWWTD scheme or Project 2CKC. Rather, following the disruption to the sludge stream during Project 2CKC and

the consequent sludge build up, I consider that it was appropriate for Thames Water to seek to bring additional sludge thickening plant onto site in early 2001 to increase the dry solids so as to catch up on the sludge backlog. The co-settled sludge problem had been overcome and I consider that, in principle, the PFTs should have been able to cope with the sludge from the PSTs.

350. Ms Thomas says that, because Thames Water engineers believed that the PFTs should work satisfactorily on primary sludge, it took some time during the course of 2001 to realise and demonstrate internally that whatever Thames Water did operationally to optimise the performance of the PFTs they were never going to perform well enough for Thames Water to be confident in relying on them in circumstances such as those following the digester refurbishment project and that expenditure was required to bring in an alternative solution. She says that her priority was to reduce Mogden's sludge backlog as quickly as possible. As a result, she says that in 2001 they looked for alternatives to the PFTs and worked with various equipment suppliers during 2001 to develop the specification for the equipment that was needed.

351. This, she says, involved sending off samples of Mogden's sludge to be analysed and then negotiating with manufacturers what parameters their equipment would have to deal with, as against the parameters that those manufacturers were comfortable guaranteeing for their equipment. She says that most manufacturers required a sludge feed to their equipment in the region of 1 to 3% dry solids. She says that the consistency of the sludge feed to the thickening plant at Mogden was never the same for very long. Her evidence was that it may have varied between perhaps 0.2% and 7% dry solids and this was one of the problems in keeping the PFTs working well.

352. Ms Thomas says that in 2001 the last thing Thames Water wanted to do was to spend money on new plant that would perform no better than the PFTs. To try and understand how additional plant would work in practice, she says that between July and September 2001 trials were carried out on the use of centrifuges, aqua belts and drum thickeners to thicken Mogden's primary sludge. She says they brought onto site a centrifuge from Beckton STW and also used one of the existing SAS belt thickeners to carry out a trial putting primary sludge through this technology. She also refers to the fact that they brought a drum thickener on site to do the same. As a result of these trials she says that they discounted aqua belts because they were not particularly effective and they also discounted centrifuges as they were completely ineffective at thickening Mogden's primary sludge. Instead she says that they decided to hire in a temporary drum thickener from Alfa Laval and in late 2001 and 2002 they progressed with acquiring and setting up this temporary drum thickener alongside the existing PFTs. She refers to the installation of this drum thickener being an onerous task and that it took approximately a month to install it and to match flows to the piece of equipment.

353. In terms of the acquisition of the temporary plant, Ms Thomas says that instead of going for the normal capital funding application to acquire new plant which could take time for approval of the necessary £200,000, she and John Kingdon carried out the installation of the first drum thickener by hiring it from Alfa Laval through an operational budget rather

than via the route of approval to capital expenditure. She says that this, in itself, was a challenge which involved lengthy negotiations with Alfa Laval who were, at the beginning, unwilling to incur the initial costs of building thickening plant to a specification that could be used at Mogden STW, on the basis of a temporary hire agreement rather than a permanent purchase by Thames Water. She says that, in 2001, drum thickeners were a relatively novel technology and when the first drum thickener was installed in February 2002 she could not be sure it would work. There were the usual teething problems with the drum thickener, she says, but it was ultimately successful and during the course of 2002 they were able to reduce the sludge backlog at Mogden STW. She says that by April 2002 they were confident enough to make the temporary drum thickener installation a permanent one and by October 2002 the sludge levels in the works had been reduced to an all-time low of 3500m^3.

354. In my judgment, on the basis of the evidence, including Ms Thomas' evidence, I consider that Thames Water acted reasonably in their approach to dealing with the situation which arose during Project 2CKC and it would not have been reasonable for them to have hired temporary sludge de-watering plant to reduce those stocks during 2000. Rather, with the benefit of the knowledge obtained through trials, Thames Water were able to arrive at a satisfactory solution. However, that does not mean that, with the benefit of hindsight, they should have installed temporary equipment earlier.

Primary Settlement Tanks: West Rectangular PSTs

355. The Claimants contend that a combination of inadequate sludge de-watering capacity, relaxed PST sludge trigger levels and inadequate de-sludging equipment and pipe work capacity resulted in excessive odours and reduced performance in relation to the West rectangular PSTs.

356. They refer to Mr Hibberd's views in his supplemental report at paragraphs 81 to 84 that Thames Water should have operated with lower sludge stock in these PSTs and that the trigger levels did not represent best practice. Mr Hibberd is also critical of Mr Gardner's evidence that the constraints within the Mogden STW infrastructure provided only limited opportunities for de-sludging each PST. His view is that those constraints should have been addressed to avoid the long sludge retention times, in particular, in the West side rectangular PSTs.

357. Thames Water refer to and rely on the evidence of Mr Gardner. In his first witness statement Mr Gardner says that once the more significant sources of odour had been tackled by Project 59HF, the West side rectangular PSTs were recognised as one of the main remaining areas of odour generation. He says that consequently they were regularly monitored and their sludge blankets kept as low as possible. He says that, in addition, a rolling programme for scraper refurbishment was in place and chemical dosing was carried out to reduce the amount of free H_2S. Because of the design of the tanks he says that it was not possible to eliminate odour completely through those steps but Thames Water have now covered those PSTs under Project 5X8F.

358. Mr Gardner, in his second witness statement, deals with the criticisms made by Mr Hibberd. First he says that the sludge trigger levels were agreed in 2005 between Thames Water and LBH as part of the negotiation to settle Thames Appeal against the July 2001 Abatement Notice. He says that as those trigger levels were agreed with LBH, who were advised at the time by the Claimants' expert Mr Peirson, there is no basis for criticism. He says that, in any event, Mogden's operators aimed to keep sludge levels in each PST as low as possible and certainly in line with or better than the trigger levels. Secondly Mr Gardner refers to Mr Hibberd's evidence that best practice requires that rectangular PSTs are de-sludged four times a day so as to keep the sludge age in the tanks below six hours. Mr Gardner says that, whilst that is laid down in the guidance, it does not take account of circumstances specific to Mogden STW. At the relevant time he says that there were 20 PSTs and SSTs in operation at Mogden STW and the age of the sludge in all of those tanks had to be kept to a minimum and each tank needed to be de-sludged regularly. As a result he states that the sequence for de-sludging aimed to make best use of the de-sludging pumps and the sludge mains on site to keep a constant feed to the sludge thickening plant and to keep the sludge volumes in all the tanks as low as possible.

359. Mr Gardner refers to a number of factors that he says influence how rapidly de-sludging can occur, such as the thickness of the sludge being produced, the size of the sludge mains and sludge pumps and the capacity of the sludge holding tanks to accept sludge. He says that the scraping and de-sludging sequence for each PST took approximately 10 to 30 minutes and that, on average, to de-sludge all 20 tanks once takes approximately 8 hours. On this basis he said it is not practicable to de-sludge the West side rectangular PSTs four times a day. He says that, overall, the de-sludging sequence aimed to keep the sludge flowing out of the PSTs and SSTs to a minimum.

360. There is no doubt that the West rectangular PSTs were a source of odour. However I do not consider that Thames Water failed to conduct operations at Mogden STW with all reasonable regard and care for the interests of others in respect of those tanks. The evidence given by Mr Gardner indicates that Thames Water carried out appropriate de-sludging processes consistent with the overall sludge capacity at Mogden STW and I do not consider that the sludge retention times, on the basis of those processes, can be criticised. In addition it complied with the trigger levels which had been set by agreement between Thames Water and LBH.

361. In those circumstances whilst the West rectangular PSTs were a source of odour, I do not consider that the de-sludging techniques adopted by Thames Water were unreasonable nor do I think that Thames Water acted unreasonably in setting the trigger levels. As a result, there was, in my judgment, no failure to conduct operations at Mogden STW with all reasonable regard and care for the interests of others in this respect.

Primary Settlement Tanks: covering

362. The Claimants contend that the PSTs should have been covered and that, in particular, covering of the West side rectangular and the East side PSTs should have been addressed as part of AMP2. They refer to Mr Peirson's main report at paragraphs 3.18 to 3.23 of his response on Particulars of Negligence 3 where he gives examples of sewage treatment

works where major odour control solutions in the form of covering were added before 2002. He says at paragraph 21.5 of his response to Particulars of Negligence 21 that where good design and good management are not sufficient to control odour emissions because a works or process is inherently odorous or where the process or works is very large or too close to sensitive receptors, then odorous facilities may have to be covered and odorous gases extracted from the covers and abated.

363. Mr Peirson says that he is of the opinion that, in mid to late 1992, any experienced odour consultant would have come very quickly to the conclusion that Mogden STW was in the "very large and/or too close to sensitive receptors category" simply because of the massive area of open settlement tanks, storm tanks and aeration lanes in such close proximity to housing. He refers to examples of covering PSTs at the other sewage treatment works and says that, having reviewed Mr Hibberd's data on the excessively long sludge retention times in the PSTs between 2000 and 2005, he does not consider that all appropriate odour control measures were in place for those tanks. His view is that, irrespective of how well the East side PSTs were managed, odour nuisance could never be adequately controlled without covering those tanks.

364. The Claimants say that the Second OdourNet Report in November 2003 made Thames Water fully aware of the extent of "cover and treat" works that would be required to bring the odour impact down to an acceptable level. In that report OdourNet concluded that their investigation of "*a range of odour mitigation scenarios*" and indicated that to reduce the level to which local residents were subject to odours to an acceptable level which, in the absence of more robust data, they defined as the "Newbiggin Criterion" of 5 odour units, would require, as a minimum, the application of cover and treat solutions to plant which included the East side PSTs and SSTs and the West side rectangular PSTs, including all associated chambers and sump, as well as the storm tanks and associated channels and storm weir.

365. Thames Water say that they acted entirely reasonably having regard to the funding authorised by Ofwat and taking all the circumstances into consideration in not covering the PSTs. They rely on Dr McIntyre's opinion that, after the 2002 OdourNet survey, Thames Water followed a measured and appropriate methodology that secured relevant funding from Ofwat for capital expenditure to install covers and abatement plant for the PSTs and storm tanks. Dr McIntyre says that this process required Thames Water to demonstrate value for money in terms of the odour emission reduction for the money spent on covering and abatement. He says that prior to AMP4 Ofwat would not have agreed to a funding mechanism for this purpose.

366. In any event Thames Water says that the conversion of the East side circular PSTs to FSTs in 2008 has solved any problem of odour arising from the former PSTs.

367. I have already dealt with the allegation that Thames Water acted in breach of their duty in failing to cover and treat the storm tanks. In relation to the PSTs I do not consider that Thames Water can be said to have failed to conduct operations at Mogden STW with all reasonable regard and care for the interests of others in failing to carry out cover and treat

work for the East PSTs prior to taking these out of service and converting them to FSTs commencing in 2008.

Sludge Digesters: Operation and Maintenance.

368. The Claimants contend that Thames Water was negligent in relation to the release of odours from ineffective seals around the digesters, due to poor maintenance and operation. The Claimants refer to the WRc report of October 1990 (UC887) in which it is stated in the summary section that:

> "*The major source of odour at Mogden Sewage Treatment Works is digester gas escaping into the atmosphere in the anaerobic digester area. Elimination of digester gas emissions would greatly reduce the overall odour problem at Mogden.*
> *It is recommended that Mogden anaerobic digesters be sealed to prevent escape of digester gas, either using flexible seals between the fixed wall and the floating roof or by conversion of the tanks to fixed roof digesters. Satisfactory technology for the implantation of flexible seals on the existing floating roof digesters is not available but it may be possible to develop suitable sealing methods. If this is not possible, replacement by fixed roof digesters may be required.*"

369. In Thames Water's November 1994 Odour Strategy report for Mogden STW they stated:

> "*It is considered that the digesters are no longer the major source of odour. We have installed two different odour control devices in the digester area: lute seals where the dome sits, and a water seal as opposed to a sludge seal has been fitted on two digesters. The third digester has a rubber seal fitted around the annulus of the dome. Current gas flow problems from digesters have been addressed by an Engineering Capital Scheme. The occurrence of inconsistent bell heights is thought to be due to these problems as well as the weight differences between newly refurbished bells and the older, more corroded bells.... If the gas flow problems can be resolved, allowing us to minimise the bell heights of digesters, then further odour control of individual digesters may not be necessary. The refurbishment of digesters will continue of a rolling programme until 1998.*"

370. Mr Peirson says that, whilst certain works were carried out by fitting larger bore pipes and a flare stack, Thames Water can be criticised for not having cured the gas leaks from the seals on the digesters.

371. In Thames Water's Odour Guidance document dated May 1995 one of the problems identified was excessive gas escaping from the water or sludge seal of a floating roof digester and it was accepted that this might lead to odour problems. It was suggested that it could be limited by maintaining a lower bell height.

372. Mr Peirson refers to the OdourNet reports and to his own observations on a site visit in December 2009. He says that the fact that substantial gas leaks persist almost 20 years after the WRc Report drew attention to odour problems caused by the digesters shows

that Thames Water have still not provided or maintained adequate digester management or gas collection and utilisation facilities. He refers to LBH's site inspection record which shows complaints on a number of occasions in 2008 and 2009 concerning digester leakage.

373. Thames Water accept that the digesters were causing odour problems in 1989, largely because of problems with the seals. They say that various experimental seals were installed in the early 1990's and by November 1994 the digesters were not thought to be a major source of odour. During the 1990s they say that a program of refurbishment works was instituted replacing digester roofs, cleaning out the digesters to remove accumulated rag and grit, replacing the overpressure valves on the digesters and increasing the gas flare capacity. They say that this reduced the build up of excess gas in the digesters and consequently significantly reduced the number of times excess gas escaped to the atmosphere.

374. Thames Water refer to Mr Cranshaw's witness statement at paragraph 62 where he says that by the late 1990s odour from the digesters had been significantly reduced and was a minor contribution to site wide odour. He refers to the H_2S mapping carried out by Thames Water in June 1997, March 2000 and July 2001 in support of this.

375. Thames Water refer to Mr Ratcliff's supplemental report where he reviews the measures designed and installed as part of the digester refurbishment project in 2000 and 2001 as recorded by Mr Summers in his witness statement. His conclusion is that the measures installed by Thames Water in 2000 to 2002 were reasonable and have provided substantial security to the digester seals. He accepts that during foaming events the digester seals are occasionally compromised but says that Thames Water moved quickly to resolve the foaming issues and thus restore the digester seals.

376. Mr Ratcliff says, at paragraph 10 of his supplemental report, that since the middle of 2008 digester seals have occasionally been compromised by the foaming of the digesters and that Thames Water doses anti-foaming agents which collapse the foam to restore the digester seal.

377. It is evident that problems with the digester seals have been present from 1990 to date, most recently in the form of foaming of the seals. In the 1990s attempts were made by experimenting with various types of seal but those evidently proved to be ineffective. During Project 2CKC in 2000 to 2003 Thames Water implemented changes to the digesters which had an impact on the surplus gas production from the digesters and so relieved the pressure on the gas which was escaping through the digester seals. It also carried out other modifications which I deal with below. I have come to the view that Thames Water acted reasonably in attempting to solve the problem of leaking digester seals and have made substantial progress. The current complaint is that there is occasional foaming of the seals giving rise to gas emission. This is being dealt with by using anti-foaming agents.

378. On that basis and having considered all the evidence I am satisfied that Thames Water acted reasonably in this aspect of operating and managing the digesters and did not fail in their duty to the Claimants.

Sludge Digesters conversion of floating roof to fixed roofs.

379. The Claimants refer to the 1990 WRc recommendation which was that either the digesters should be fitted with flexible seals if the technology could be made to work or if the seals could not be made to work, then the roofs should be fixed. They point out that trials were carried out with seals but no permanent solution has yet been deployed to date. They refer to Thames Water's Mogden Odour Study of December 2001 which, at paragraph 2.2.5, deals with the problem of digester seals leaks when the gas pressure in the digester dome rises, causing the dome to rise. Thames Water's solution was to prevent high dome heights by active dome management. The report said that each of the 16 digesters would be provided with an actuated valve to control the gas take off and that this would allow the control of each individual digester dome height.

380. The Claimants also refer to the OdourNet report of November 2002 where, in the conclusions, it was stated:

> "*The first step in reducing the impact is to identify measures by which the current treatment process and operations can be optimised to minimise the generation of odours at source. Based on our investigations conducted during this study, the recommendations described below are made.*
> …
> *Modify the gas management system for collection of gas generated from the digesters to prevent release of gas directly to atmosphere. Prevention may require provision of suitable odour control (e.g. carbon filters) to ensure that any remaining releases are treated prior to entering the atmosphere.*"

381. They also rely on the Second OdourNet Report in November 2003 which states:

> "*The other key source of odour associated with the sludge treatment area is release of gas from the digesters. It is understood that the regular release of gas is due in part to the current operational regime of balancing the extraction rate of digester gas from each digester to the gas engines. Due to the significant variation in the generation of gas from each digester at any given point, balancing of extraction cannot be sufficiently controlled to prevent release. Although in overall terms, the total odour emission associated with the release of digester gas is relatively low, it is important to note that concentrations of these releases are likely to be extremely high (measurements conducted in 2003 indicated concentrations of over 80,000ou$_E$/m3). As a result, the gas will require considerable dilution before the odour is reduced below the threshold. Such releases are therefore highly significant in terms of complaint behaviour and must be avoided if a satisfactory reduction in impacts off site is to be achieved.*"

382. Although the Claimants accept that works were done on the digesters in 2000 to 2003 they point out that the digesters were still causing problems in June 2004 and refer to a Mogden STW condition survey of June 2004 which states as follows:

> "*Digester clearing blowing off gas-sufficient to blow sludge onto the ground. Especially on the digester bell at its top level. Recommend review of options.*"

383. Thames Water submit that, as Mr Cranshaw explained on Day 4, it has been a continuing challenge to balance together, on one common gas main, 16 or 20 digesters, each of which are equipped with a floating roof and have subtly different weights and friction losses. Mr Cranshaw says that since the automation in 1990 the operators have an electronic indication of the bell height and they have a clear instruction to manage the gas so as not to allow releases. He says that they have to manage the bell heights downwards, either through the use of the engines to consume gas or by destroying the surplus gas in the waste gas burner.

384. He was asked in evidence on Day 4 whether some form of improvement of the plant, for instance, a fixed roof or a means whereby escaping gas could be collected and prevented from entering the wider atmosphere, could have been an option during the 20 year period. He said he agreed. He said he did agree that fixing the roof would have brought about a significant step-change but that would necessitate the provision of an external gas holder. He said he thought the reason why that solution was not adopted was that it would have necessitated the conversion of the digesters from a draw and fill arrangement to a displacement arrangement which would have required major civil and hydraulic modifications but he did accept that this technology was available in the early 1990s, just as it was today. Mr Cranshaw said that the cost of the solution would have been a major factor and he accepted that no application had been made for funding to carry out that work.

385. Thames Water say that the position has been significantly improved since the installation in 2003 of the automatic control system to prevent digester seal failure. This system, installed as part of Project 2CKC, operates by providing each digester with a radar level sensor. These sensors, or detectors, are then linked to automatic valves to allow the rate of gas take-off to rise and fall in line with digester bell heights. Thames Water rely on Mr Cranshaw's evidence that this, together with other alterations has meant that, for at least the past seven years, the digesters on the whole can be operated without allowing gas to escape from the digester seals. The other alterations include the installation of an additional third gas main to increase capacity for drawing off digester gas for use in the combined heat and power engine; refurbishment and cleaning out of the existing gas pipe work to remove blockages and installation of condensate traps on all three gas mains to drain water which could cause blockages in the gas mains. Thames Water also contend that the Claimants have significantly under estimated the complexity of installing the fixed roof and gas bag scheme recommended by Mr Hibberd.

386. It is evident that problems with the digesters have been apparent at Mogden STW since the 1990s. The solution proposed was either to make a more effective gas seal around the

digesters or, if that could not be done, to fix the domes of the digesters. Thames Water therefore reasonably, in my judgment, sought to make modifications to the digester seals in order to overcome the problems. It experimented with various forms of seal but it was unsuccessful in providing a form of seal which was capable of retaining the gas within the annulus around the digesters. In my judgment, it was at that stage that consideration should have been given to some further method.

387. From the evidence set out above it is apparent that in the period between 2000 and 2003Thames Water pursued and installed the solution which has adopted an automatic control system to prevent digester seal failure.

388. The result has been that, apart from the problem with foaming which I have referred to above, the emissions from the digesters have been minimised by this process. In all the circumstances I do not consider that Thames Water failed to conduct operations at Mogden STW with all reasonable regard and care for the interests of others in their approach to the digester problem.

Odour Control Units

OCU: PFT/Sludge bioscrubber

389. The PFTs had provision for the extraction of air which then went through an OCU. Originally, between 1993 and May 1995, the PFTs worked in a parallel operation, in the sense that the air from two tanks each passed through one of two chemical scrubbers. Between May 1995 and August 2001 Thames Water introduced WRc bioscrubbbers from Beckton STW. Those were again used in parallel operation except that between August 2001 and October 2001 the bioscrubbbers were operated in series as one of the bioscrubbbers was out of commission during that period. From October 2001 to January 2003 the plant then returned to parallel operation. There was another change between January 2003 and May 2005 so that the layout was altered again to series operation. In 2005 the plant was decommissioned when the PFTs were replaced by other sludge thickening plant.

390. The Claimants refer to an email of 21 August 1999 from Mr Cranshaw to Mr Glass which was written following a site visit. In relation to the bioscrubbbers serving the PFTs, which also had a feed in from the supernatant liquor pumping station, he expressed the following views:

> "*The initial appearance of the units is very poor this is largely due to ponding of sewage effluent around the units from a leaking flange on the main body of one unit. The local flooded area has accelerated the corrosion of the cable trays and supports in the area.*
> *Both units had fans running but one unit showed no flow apparently due to a broken fan drive belt.*
> *The adjacent unit showed a really low shaft speed on the fan, the motor had been replaced with a unit 50% smaller (in physical dimension).*
> ...

> *The ductwork was in poor condition with some taped joints and a clearly asymmetrical system without balancing dampers between the PFTs.*"

391. In a summary produced on 8 January 1999 Ms Tracey Williams set out her recommendations for improvement to the sludge stream. In relation to the PFTs she said:

> "*The PFT area currently has two bioscrubbbers. Until recently the pipe work to these had been in disrepair and therefore it is believed that the media in them was dead. Both units would benefit from an overhaul to ensure they are operating effectively.*"

392. Mr Peirson refers to monthly odour control unit monitoring sheets produced by Mr Adrian Wallis on various dates in 2000 and 2001. The first is dated 1 November 2000 in which, in relation to PFT Bioscrubber 1, it is commented: "*Poor apparent performance no water supply, air supply needs checking.*"

393. Secondly, on 26 March 2001 Mr Wallis refers to PFT Bioscrubber 1 again and says: "*Performance virtually nil - Urgent Attention required as this is pumping out high levels of H_2S.*"

394. Thirdly, on 3 July 2001 in relation to the PFT Bioscrubber it is stated "*Performance still very poor….. pumping out high H_2S levels Urgent Attention required or divert flow to unit 2 which may cope - monitoring required to assess.*

395. Fourthly, on 21 August, 18 September, 25 September, 3 October, 18 October 2001 it is reported that the unit was currently out of commission awaiting refurbishment. The sheets for 25 September 2001 onwards were filled in by Barry Wyeth.

396. Ms Shelley Thomas deals with the PFT Bioscrubbers in her witness statement. She refers to maintenance records which show that a maintenance call was made on 29 November 2000 and a second call on 30 April 2001. She says she recalls spending a considerable amount of time chasing the maintenance contractor, Engenica, between March and July 2001 for a new water pump for the bioscrubber. She said because of the continuing delay in obtaining this pump, in July 2001 as recommended by Mr Wallis, Thames Water took PFT Bioscrubbber 1 out of commission and ducted the air to PFT Bioscrubbber 2 as a temporary solution. She says that this solution was effective at abating odour from PFT Bioscrubber1 with the H_2S level for the combined flows at 0.32 ppm down from 12 ppm for PFT Bioscrubber 1 in July 2001.

397. Ms Thomas says that the replacement pump arrived in late 2001 and Bioscrubbber 1 was then re-commissioned. She recalls that there were concerns in 2002 caused by the sludge stream at Mogden STW. She said that because they are a biological process, the bioscrubbers were not always very good at responding to rapid changes in odour load and she said it was an uphill battle to keep the OCUs functioning while still addressing problems with the sludge stream. She said that therefore during 2002 they tried to

improve the performance of the bioscrubbers by tackling the root cause which was the PFTs themselves.

398. Mr Peirson also refers to the First OdourNet Report of October 2002 where at section 5.1.2, dealing with sludge treatment and handling, they said that the primary source of emissions from this area was associated with emissions from the odour control units. In relation to the PFT Bioscrubber they said that the measured efficiency of treatment for both scrubber towers was negative, implying that in addition to release of the sludge odours extracted from the tanks, the towers themselves were generating odour emissions. The right hand fan was found to be extracting at 10% of the extraction rate applied by the left hand tower. They commented "*the current situation is likely to be highly significant in terms of odour annoyance, since the odours released from these sources are likely to be concentrated, and highly offensive. Refurbishment or replacement of all four of these odour abatement units with operational plant is thus identified as a priority issue.*"

399. At paragraph 21.5.15 of his main report Mr Peirson says that these findings of poor OCU performance in 2002, following Mr Cranshaw's observations in 1999 and the Odour Monitoring Records sheets in 2000 and 2001 demonstrate that the performance of the PFT Bioscrubber OCUs had not been effectively monitored and that remedial measures had not been put in place when performance deficiencies were identified.

400. Mr Peirson also refers to the Second OdourNet Report in November 2003 in which at paragraph 1.4.2 it was stated that the two Bioscrubbers serving the PFT tanks were refurbished and reconfigured to operate in series. At paragraph 3.2.2 they said that although there was evidence to indicate that the level of containment of odorous air had been increased by the modifications the level of containment of the PFTs remained less than optimal. They said that although the source of the odour from the PFTs was not confirmed, it was likely that the extraction rate applied to the tanks was insufficient fully to contain the odours from the tanks.

401. At paragraph 5.1.2 they suggested that the level of capacity of the PFT Scrubber should be increased and that the results of the measurement program indicated that the residual odour released from the PFT Bioscrubber remained high, measured at 20,000 odour units.

402. In the September 2004 OdourNet report at paragraph 3.2.2 it was stated that the results of the odour abatement efficiency assessments were broadly comparable to the measurements in 2003. They said that in terms of abatement efficiency there had been an apparent drop in efficiency for the PFT odour control plant but that was more likely to be due to the decrease in load rather than any specific operational problems. They said that from an impact perspective it was clear that the magnitude of emissions was similar or below that measured in 2003.

403. The Claimants also refer to a table summarising the results of testing of odour control units at Mogden STW between 2002 and 2009. In 2001 it is indicated that the plant was not tested or that the percentage abatement did not meet the 95%+ performance criterion. In 2002 it is shown that the emissions were 60,000 odour units with results of -146% and

-298% abatement. In 2003-2005 there was refurbishment between January and July 2003 and then 19,000 odour units in 2003 with 87% abatement and 22,800 odour units in 2004 with 75% abatement. As mentioned above these units were decommissioned when the sludge thickening was changed from PFT in 2005.

404. On the basis of the above evidence Mr Peirson, at paragraphs 21.11.4 to 21.11.5 of his main report, summaries his view that the evidence shows that the bioscrubbers were not performing to an adequate standard between 1999 and 2002 and that whilst they were operating at a higher level of abatement in 2003, the poor state of the odour containment facilities observed by OdourNet demonstrated that Thames Water had not carried out the recommended checks on extraction and containment and had ignored visual and odour evidence of odour leaks and poor containment. At paragraph 21.11.13 Mr Peirson says that, taken as a whole, the history of abatement plant performance since 1999 shows inadequate responses to poor abatement plant performance and the failure of Thames Water to act in accordance with their own best practice. He says that the consequences had been significant offsite odour nuisance contributions.

405. Thames Water refer to a document in June 1998 concerning Project 4V8C which related to PFT OCU refurbishment at Mogden STW. It said that the PFT had been identified as the source of one of the major odour complaints at Mogden and that refurbishment of the OCU associated with the PFTs, together with replacement of the media, would result in reduced levels of odour from that area.

406. Thames Water also refer to Mr Cranshaw's witness statement where he said that between July 1998 and March 1999 the PFT Bioscrubbers were refurbished, including replacement of sprays and fans, repair of PFT pipework plus replacement and reseeding of the biological media.

407. Thames Water refer to the Odour Strategy Review on 24 September 1999 by the group which had been set up to reduce the impact of odour on the area surrounding Mogden STW. That was followed on 21 October 1999 by a further meeting at which it was said: "*PFT Odour Control (Bioscrubbers) to be correctly sized, flooding of Rh Unit rectified and fully operational by 31 March 2000.*" Mr Cranshaw refers to an updated action matrix produced on 8 December 1999 where in the response to a question as to whether the Bioscrubbers were performing adequately it was stated "*Independent performance checks (Ian Cranshaw) carried out and found satisfactory apart from access and minor deficiencies.*"

408. Thames Water accept that dates for the following period are difficult to reconstruct because regular H_2S monitoring did not commence until later in 2000 and surviving records are sparse. Thames Water submit that, although there appears to have been some problems with the OCUs on occasions in 2000 and 2001, they did all that they reasonably could to remedy the problems which were essentially precipitated by variable H_2S loads from sludge processing and they refer to the evidence of Ms Thomas on this aspect.

409. Thames Water say that, in response to faults developing on PFT 1 OCU, air flows were redirected to PFT 2 OCU in July 2001 and there was good H_2S performance until PFT 1 OCU was refurbished and put back into commission again in October 2001.They say that the PFT OCUs then worked efficiently for so long as the H_2S records last. They accept that both PFT OCUs were found not to be working in September 2002 when OdourNet tested. Thames Water rely on Ms Thomas' evidence on day 12 where she said that the fundamental problem with getting the OCUs to work effectively was the fact that odour control units work best if they have a constant flow of H_2S odour into them but with the sludge from the PSTs on the East side, the SSTs on the East side and the West side PSTs together with post-settled sludge, the variability of the load meant that the biological process was not able to deal with the variability of the odour. Ms Thomas said that the OdourNet results in 2002 did not surprise her because OdourNet were brought in to help confirm and quantify the problem areas in terms of odour. She said that her three main "bugbears" were the PFTs, the settlement tanks and the storm tanks and this was essentially confirmed and quantified by OdourNet.

410. Thames Water say that after OdourNet reported in October and November 2002 they applied to the Capex committee for funding to refurbish the PFT OCUs. They refer to a document prepared for Project 3YMD Mogden STW Odour Mitigation (phase 3) which set out investment recommendations for reducing odour emissions and stated that it was part of a phased approach for dealing with this high-profile issue under the Mogden Odour Action Plan. It said, in relation to the OCUs, that the existing units were ineffective and required refurbishment.

411. Thames Water then refer to a technical specification produced in January 2003 for Project 3YMD in which item 3 of the work of refurbishment of the thickener area odour plants consisted of reconfiguring the whole of the PFT OCUs to operate as a two stage bio-filter. The program was to be carried out so that the plant was re-commissioned by middle of April 2003. They refer to a report in May 2003 in relation to Project 3YMD in which it is stated that the refurbishment of the sludge thickening area odour control equipment has all now been completed.

412. They accept that, by reference to the weekly Odour Control Unit Monitoring Report of 22 July 2003, which is the only report before 16 October 2003, the PFT OCUs were stated to be "not working". It is also accepted that, as stated by Dr McIntyre in his main report at paragraph 4.1.93 that there were certain periods when Thames Water were aware that OCUs were not performing and it might appear that remedial action could have been initiated earlier. Those periods were August 1999 to Spring 2000 and October 2002 to May 2003. Thames Water say that the above chronology shows that although there were problems Thames Water acted reasonably.

413. The performance of the PFTs was a matter which, as I have referred to above, caused concern over an extended period up to 1999 when they started to operate solely on primary sludge and not on co-settled sludge. The purpose of the OCUs was clearly to avoid the consequences of the necessary odour created by the process of the PFTs. In

those circumstances I consider that the proper testing and maintenance of the OCUs was a major requirement for any careful operator of a sewage treatment works.

414. From what has been said above I consider that the evidence shows that in periods between 1999 and 2005 Thames Water failed to have a careful system of testing and maintenance in relation to the OCUs. Whilst I accept that Thames Water mitigated the effect once it became clear that the OCUs were not operating and needed refurbishment or alteration, I am satisfied that there were significant periods of time between 1999 to 2005 when the odour control units were not operating correctly and when, despite the provisions within "Thames Water Utilities Best Practice Operations Manual" at section 7.7 requiring detailed ph and other checks to be carried out for the bioscrubbers, such checks were not properly or consistently carried out.

415. In those circumstances I consider that during periods from 1999 to 2005 there were odour emissions from the PFTs which were caused by Thames Water's failure, in breach of their duty to the Claimants, to carry out proper testing and maintenance of the PFT OCUs.

OCUs: sludge reception

416. The Claimants criticise both the performance of the bioscrubber installed in 2001 for the sludge import and thickened sludge holding tank (TSHT) and also the new imported sludge and thickened sludge storage PMG Carbon Unit installed in 2003. The history of the OCU serving this area is dealt with in Witness Statements of Mr Cranshaw, Ms Thomas and Mr Gardner.

417. Mr Cranshaw explains that in June 2001 Black and Veatch installed a new bioscrubber to replace the old WRc bioscrubber which served the thickened sludge holding tanks. He says that, in accordance with Thames Water's standard practice document C10 of September 2000 (SPD-C10), the bioscrubber ought to have been specified to achieve 95% H_2S abatement and a 60 second media contact time which were aimed at producing over 99% abatement. However, when subcontracting the supply of the OCU, Black and Veatch wrongly specified this unit and the contact time for the bioscrubber was actually only some 15 seconds. He says that when the new TSHTs bioscrubber was commissioned in late 2001 it was found to be unable to achieve reliably an abatement level of 95% or more.

418. Ms Thomas says that she first arrived when this bioscrubbber was being installed and refers to her July 2001 Monthly Exceptions Report and Adrian Wallis' OCU Monitoring which shows that the OCU achieved only approximately 85% odour abatement, as compared to the specified 95% to 99% abatement. She refers to better performance in August 2001, to attempts to improve performance in October 2001 and to figures showing that in January 2002 the abatement varied between 40% and 100% with an average of 85%.

419. Mr Cranshaw says that attempts to optimise the new bioscrubber did not produce a satisfactory level of odour abatement and in early 2002 Thames Water decided to replace

the wrongly specified TSHT bioscrubber with a correctly sized OCU as part of Project 3YMD. This led to the TSHT bioscrubber being replaced in March 2003 by a granular activated carbon unit produced by PMG.

420. Mr Gardner says that during 2003 and 2004 this PMG OCU preformed well, as demonstrated by the OCU Monitoring data. He said that the new pasteurisation plant was then commissioned from May 2005 and with the installation of this new pasteurisation stage in the sludge stream, between sludge thickening and digestion, the TSHTs were converted into pasteurised sludge holding tanks. He says that OCU performance monitoring first picked up a problem with the PMG unit on 13 June 2005 when H_2S readings were 1.1 to 1.2ppm, above the 1.0 ppm trigger level. On 24 June 2005 readings were 1.3-1.5ppm. However Mr Gardner says that OCU performance improved by the end of June and remained below the trigger level in July and part of August. He says that in June 2005 PMG staff were monitoring the OCU performance as part of the pasteurisation commissioning process and detected reduced performance of this OCU. They therefore replaced the carbon in this OCU in mid July 2005. Despite this, for a short period in August 2005 and again in November and December 2005 the OCU was found during monitoring to breach the 1.0ppm trigger level.

421. Mr Gardner refers to the OdourNet report produced in September to October 2005 which showed that, for this OCU, the emission was over 100,000 odour units representing some 31% of the total site emissions. The percentage removal of H_2S was some 95% but the percentage odour abatement was 82%.

422. In January 2006 the managing director of PMG visited the site. In an email he reported that, on analysis of the samples of the carbon bed, it was very wet, the alkaline impregnate was still present and active but physical absorption capacity of the carbon was being compromised by the high humidity. He reported on low H_2S outlet readings but said that, despite this, there was a definite "cabbage like" odour in the outlet air, attributable to the presence of chemicals which would normally be absorbed by the carbon. He said that the high humidity was of concern and much more condensation had been noticed since the conversion of the two sludge vessels. He said that the humidity should enhance rather than reduce the efficiency of H_2S removal as this is dealt with by the alkali impregnate. He said that the cabbage like odour could be removed by installing a second stage vessel containing a suitable base activated carbon.

423. Mr Gardner says that, in January 2006, he forwarded this email to Mr Pettit of Thames Water's Engineering Department together with a letter of 27 June 2005. The letter of 27 June 2005 from PMG stated that the existing system was more than adequate to provide effective odour control for the modified sludge tanks. However it noted two concerns as follows:

> "*We understand that the temperature of the pasteurised sludge will be above ambient and therefore the air being extracted is likely to be at a higher humidity. This makes it even more important that the vessel and duct work drains are checked regularly for blockage, particularly during the winter.*

> *The original design basis for the odour control unit was for the carbon media to have a 2 year life based on an average odour level of 20ppm H_2S. We are aware that the odour levels are often in excess of this concentration but are unsure whether the plant modifications will result in the odour control unit having to deal with a further increase. However during our installation period, we did detect a slight odour from the unit that may suggest that a carbon refill is overdue."*

424. Mr Gardner says that, following the email exchange, carbon media in the PMG unit was replaced and in early 2006 Thames Water investigated what was causing the problems so as to try and rectify those during the commissioning of the pasteurisation plant. He says that the high humidity in the OCU was eventually confirmed as being due to the fact that air from the pasteurised sludge which passed through the OCU was hotter and wetter than anticipated and contained a very high level of H_2S, up to 1,200 ppm. He said that the presence of hot air combined with cooler surfaces of the OCU caused the water vapour to condense around the carbon media, which reduced the media's effectiveness.

425. He says that in March 2006 the PMG unit was taken out of service while investigations were carried out and that in April 2006 the PMG unit was returned to service with pasteurisation not running and the carbon media replaced with a more moisture tolerant grade. The aim, he states, was to test OCU performance alone, before testing its performance with the pasteurisation plant running. However, by June 2006 the PMG unit was again found to be exceeding the H_2S trigger levels and this happened even when pasteurisation was shut down.

426. Mr Gardner says that steps were taken to try and improve performance by, for example, agitating the carbon media and adjusting the air flow rates but the OCU's performance did not improve. In late 2006 investigations revealed that the high humidity had caused the carbon media to contract and collapse the internal supports in the OCU. As a result of these discussions it was decided to carry out works temporarily to duct part of the air from the pasteurisation holding tanks to the sludge thickening building OCU so as to remove part of the load from the PMG unit and that work was completed by the Summer of 2007. Whilst this reduced the odour from the PMG unit there was concern that it overloaded the thickening building OCU.

427. In November 2007 Mr Gardner says that an internal capital application was put in for £133,800 for a new Peacemaker activated carbon OCU which was designed to cope with high humidity. He says that funding was granted and this OCU was installed in March 2008 so that once this OCU was fully commissioned in mid 2008 odour from the sludge import area was significantly reduced.

428. The Claimants' main criticism is that this OCU was ineffective after pasteurised sludge was diverted to the TSHTs dealt with by this OCU. They criticise both the control and testing of this unit, given what they say was known to Thames Water. In that respect they refer to the Second OdourNet Report in November 2003 which said that the refurbishment of the OCU had achieved a substantial reduction in emissions but that:

> "*If these benefits are to be fully realised in the longer term, it is of course imperative that these units are maintained. From this perspective, regular monitoring of the treatment efficiency of the plant is recommended, particularly for the carbon unit serving the imported sludge tank which will require regular media replacement at the light loads noted during the survey.*"

429. The Claimants also refer to the letter from PMG of 27 June 2005. Mr Peirson considers that the problems identified in the OdourNet Report of 2005 were likely to be the result of the PMG unit being either overloaded/undersized or of possible exhaustion of the treatment media. He says that in the light of the warnings from OdourNet in 2003 and from PMG in 2005, Thames Water should have had the unit tested in 2004. He also says that, despite Thames Water being warned that the unit would require regular monitoring, they only picked up the problem when OdourNet carried out the testing in 2005. He refers to the fact that the weekly monitoring of this OCU had shown consistent failures to meet the H_2S trigger level of 1.0ppm.

430. In a table in which Mr Peirson provides an analysis of readings which were outside of that limit, it is evident from June 2005 to September 2008 that there have been periods when that trigger level has been exceeded or when no readings were taken, apparently because of a failure to use the H_2S Jerome meter.

431. Mr Peirson says it is a very well established limitation of activated carbon that it does not absorb odours very effectively at high air humidity. He says that the problem of condensation was a predictable outcome of Thames Water's decision in 2005 to divert warm sludge from the pasteurisation system to the sludge tanks controlled by the PMG OCU. He says that the media used in this OCU, whether mainly activated carbon for the PMG unit or a higher proportion of chemical oxidising material for the Peacemaker unit will always have a limited life, depending on the combination of the concentration of odorous compounds and the volume or weight of activated carbon and chemical oxidants in the filter. Mr Peirson says that, for this reason, it is critically important that such abatement units are very carefully monitored to determine when the carbon is fully saturated or the chemical oxidation component of the media has been depleted so that the media can be changed as soon as it is spent.

432. From the records he has seen Mr Peirson says that the OCU was checked reasonably regularly with a Jerome Meter to monitor H_2S abatement but it was only subject to testing in 2005, 2007 and 2008. He says he sees no evidence of testing in 2006 and understands that testing in 2009 was delayed because the plant was out of use when OCU testing took place so that no data had been provided to LBH by the end of December 2009.

433. Mr Peirson says, in summary, that this OCU was not consistently performing to an adequate standard between June 2005 and February 2008, even based on the 1.0ppm H_2S limit. He says that Thames Water apparently did little to rectify this situation. He said that, in terms of annual olfactometry, no olfactometric testing was carried out in 2006 but

he says that there is no evidence to suggest that the OCU performed any better in 2006 than it had in 2005 and 2007.

434. Thames Water say that they acted reasonably in relation to the performance of this OCU and the problems which arose. They say the replacement bisocrubber installed in June 2001 was wrongly specified but, despite this, performance in 2001 was acceptable and the replacement OCU was installed between January and March 2003. They say that the PMG Carbon Unit installed in March 2003 worked well in its original role and they refer to Mr Peirson's evidence on Day 13 where he accepted that the PMG Carbon Activated OCU had appeared to perform well enough prior to its reconfiguration in May 2005, so as to deal with pasteurised sludge.

435. Thames Water accept that the introduction of pasteurised sludge into the TSHT from that date caused a deterioration in the performance of the OCU. They say that they acted reasonably in taking the view that the existing PMG unit would be adequate to cope with the anticipated load and then in taking action to deal with the problem once they became aware of it.

436. There was evidently a problem in June 2001 when the original bioscrubber was wrongly specified and it was inadequate particularly in 2002. The installation in March 2003 of the PMG Carbon Unit was therefore an improvement and, until it was decided to pass the warm pasteurised sludge to the tanks when pasteurisation was introduced in May/June 2005, the performance of the OCU appears to have improved. There was, however, no record of testing or no testing was done in 2004. It is evident that problems arose with the pasteurised sludge being passed to the TSHTs and with the condensation arising from the consequent humidity.

437. I accept the evidence of Mr Peirson that it is a well established limitation of activated carbon that it does not absorb odours very effectively at high air humidity and particularly if the carbon becomes wet with condensation. He points out that the PMG system and the Peacemaker unit have impregnated oxidising agents used to oxidise H_2S, which is one of only a few odorous gasses which are not effectively trapped or absorbed by activated carbon. He says that activated carbon has a limited life and it is critically important that such units are very carefully monitored so that the media can be changed as soon as it is spent.

438. In this case, as Mr Peirson said, there were two pieces of advice which should have put Thames Water on notice that activated carbon systems would not be effective, particularly after pasteurisation was introduced. First, in the 2005 OdourNet Report it was stated that the results of testing on the OCU were "*indicative of either an overloaded/undersized unit, or possible exhaustion of the treatment media*". Secondly, PMG were clearly concerned at the operation of the activated carbon with high levels of moisture and condensation.

439. Whilst there is evidence of the media being replaced in mid July 2005 and in early 2006, it does not appear that Thames Water properly monitored the carbon media in the period

between July 2005 and the OdourNet report in November 2005 or during 2006. Indeed it does not appear that it was until late 2007 that Thames Water took any steps properly to deal with the problem.

440. In the circumstances I consider that Thames Water did not act reasonably from mid 2005 to the end of 2007 in dealing with this OCU and fell short in their monitoring and operation of this OCU. As a result they were, in my judgment, in breach of their duty to the Claimants.

OCU: Sludge thickening building

441. The Claimants contend that the performance of this OCU deteriorated from being acceptable in 2005 to being very poor in 2009. They say that maintenance was not carried out, for example replacement of activated carbon media after poor test results and that the plant was not properly tested to demonstrate proper performance and that no olfactometric testing was carried out in 2006.

442. This biofilter OCU serves the raw sludge tanks and the thickening building. It was installed in 2005 and when it was tested in October/November 2005 by OdourNet the odour emission was 3,907 odour units with 99.8% odour abatement and 99.3 % H_2S removal. There was no test in 2006. In 2007 Mr Peirson assessed that the emissions had risen to 13,139 odour units showing that its performance had declined since 2005. The 2008 OdourNet report showed that this had increased to 19,945 representing 34.4 % of site emissions. In the 2009 OdourNet report the figure had increased to 37,064 odour units and the following comment was made:

> "*The Sludge Thickening OCU is currently achieving an odour removal efficiency of 91% for odour and 98.2% for hydrogen sulphide. However, the carbon unit does not appear to be functioning, and as a result the residual odour concentration released from the unit is higher than expected for a unit of this kind (-38,000 $ou_E/m3$). The results suggest that the carbon contained in this unit has reached the end of its operational life and is in need of replacement.*"

443. The Claimants rely on the view of Mr Peirson who says that Thames Water were not generally proactive about monitoring and maintenance of OCUs. In relation to this OCU he says Thames Water should have taken remedial action and re-tested the sludge thickening building biofilter after the poor performance in the 2007 test. Ideally he says that the plant should have been first repaired and maintained to restore it to a suitable level of performance and then should have been retested before the summer of 2008. It was not best practice, he says, to find that this OCU was again not performing to an acceptable level in 2008. He also expresses the view that the fact that the sludge thickening building biofilter was apparently not subject to olfactometric testing in 2006 meant the possibility of three consecutive years of poor performance cannot be ruled out. The Claimants also refer to Dr McIntyre's evidence when he accepted that it looked as if the emissions were consistent with a progressively deteriorating OCU.

444. Thames Water accept that this biofilter was not working effectively when tested by OdourNet in 2009 but they say it was achieving acceptable odour abatement in 2007 and 2008 albeit from high loads. They submit that the court should be cautious in drawing too much from the one reading in 2009.

445. I consider that Thames Water did not act reasonably in their operation and maintenance of this biofilter and that as a result its performance deteriorated so that by 2009 it was the largest contributor to odour emissions on the site. It does not appear that any proper maintenance was carried out and I note that in Summer 2007 it was decided to carry out some temporary works to divert part of the air from the pasteurisation holding tanks to this building's OCU to remove part of the load from the PMG Sludge Reception OCU.

446. In the circumstances I consider that Thames Water did not act reasonably in dealing with the operation and maintenance of this OCU and were in breach of their duty to the Claimants.

OCU: sludge pasteurisation

447. The Claimants contend that Thames Water failed to provide reliable and effective abatement for the sludge pasteurisation plant.

448. Mr Gardner deals with this OCU in his witness statement. He explains that the pasteurisation OCU is an ERG wet chemical scrubber unit designed to achieve an outlet air odour concentration of 1,000 odour units. He says it was commissioned in May 2005 and almost immediately proved to be problematic. He recalls that it used up chemicals at a much faster rate than it was designed to use. He says that problems were first identified during commissioning although at first, in early 2005, the OCU achieved adequate levels of odour abatement, with an H_2S reading of less than 1.0ppm, except on three occasions between May and October 2005.

449. He says that olfactometric testing carried out as part of the commissioning revealed that it was not achieving its designed outlet specification of 1,000 odour units. As a result, commissioning ceased in November 2005 and ERG were asked to investigate. He says that in November 2005 iron dosing was introduced year round in the PSTs to reduce the loading on the pasteurisation OCU. The OCU unit was, he says, found to be performing inadequately in 2006 and Costain, who were responsible for the overall works of which this OCU was part, found and reported in June 2006 that the OCU was performing to high efficiency by removing 99% of the odour but that there was still a residual odour greater than the specified 3,500 odour units. Costain said that based on the olfactometric tests and from practical experience on site the discharge from the stack was not offensive.

450. Mr Gardner says that Thames Water did not put in place the recommendation by Costain that the installation of a heater, followed by a carbon filter, could reduce the emission to below 3500 odour units because the odour was inoffensive. He says that during 2006 and 2007 Thames Water did make various changes to the ERG Unit changing it to a three stage from a two stage unit and upgrading various components. He says that as a result it was anticipated that the OCU would be able to achieve an outlet H_2S concentration of

1.0ppb and a maximum odour emission at times of peak load of 3,500 odour units. He says that in early 2006 in order to provide a back up OCU for use if the ERG unit's performance became unacceptable, a thermal oxidiser was installed but in August 2006 minor explosions occurred in the thermal oxidiser plant. These were found to be caused because small amounts of methane had built up which were not anticipated. This meant that from early 2007 the thermal oxidiser has not been used. He says that a new biofilter was being procured to replace the thermal oxidiser and act as a backup for the ERG OCU.

451. As a result of the problems experienced with pasteurisation OCU, Mr Gardner says that the pasteurisation process would be shut down completely for extended periods during 2005 to 2008 rather than allow the process to continue with unacceptable OCU performance. He said that during the first year and a half following the installation of the pasteurisation plant it was run for approximately half this time, that is for nine months. He said that the pasteurisation has only been running continually since December 2008.

452. In the 2009 OdourNet report, although the plant is said to be achieving 99% odour abatement efficiency, the emission level is still 21,318 odour units. OdourNet said as follows in relation to this unit:

> "*The Pasturisation unit OCU is currently achieving an odour removal efficiency of >99% for both odour and 99.8% for hydrogen sulphide. The residual odour concentration released from the unit is however higher than expected, measured at 21,000 ou_E/m3. This high residual concentration may be due to overdosing of hypochlorite chemical in the scrubber system, which gives the treated air a distinctive 'swimming pool' odour. It is recommended that the operational conditions and dosing set-points for this unit are reviewed to assess whether there is any room for modification to better match the odour load presented to it.*"

453. In December 2009 LBH served an Abatement Notice on Thames in respect of nuisance arising from the operation of this OCU serving the sludge pasteurisation plant.

454. The Claimants say that since 2005 Thames Water has been aware of the need to abate odours from the pasteurisation process and still have to find a satisfactory solution.

455. Thames Water accept that there are plainly difficulties in relation to the load generated by the pasteurisation plant which is sought to be abated by this OCU. They refer to Mr Peirson's evidence on Day 13 when he accepted that his judgment has been based on 2009 data because he did not have enough information about the prior position. He accepted that odour from pasteurisation plants is one of the most difficult odours to abate but it was important not just to look at the percentage abatement but at the absolute odour concentration of 21,000 odour units.

456. From the evidence of Mr Gardner it is clear that there have been problems with this OCU since 2005. It was closed down completely for extended periods during 2005 to 2008 so that it ran for only about nine months during this period. It commenced running

continually in December 2008 although there have been periods when the pasteurisation process has not been running. I understand that either prior to or on service of the abatement notice in December 2009 Thames Water have stopped operating the plant.

457. However, during the period between December 2008 and late 2009 it is clear that the odour from the pasteurisation plant has been at high levels. It seems that at least from June 2006 Thames Water were aware of the problem and although they installed a thermal oxidiser, they did not pursue other avenues before they decided to bring the plant back in operation in 2008.

458. I consider that Thames Water did not act reasonably in bringing the plant back into operation in December 2008 knowing that they did not have a properly operational OCU. They were, in my judgment, in breach of their duty to the Claimants in that respect.

General summary on odour control units

459. In the evidence and submissions reference was made to other OCUs not referred to in the Schedule of Failings, including the new East main OCU, the supernatant pumping station OCU and the digested sludge transfer OCU. These also suffered from problems which resulted from Thames Water failing to act reasonably in relation to the maintenance, operation or monitoring of OCUs. I have come to the conclusion that the situation is correctly summed up by what Mr Peirson says at paragraph 21.11.13 of his main report that, taken as a whole, the history of abatement plant performance since 1999 shows inadequate responses to poor abatement plant performance and the failure of Thames Water to act in accordance with their own best practice leading to significant offsite odour.

Odour Control Unit H_2S Trigger Levels

460. The Claimants contend that Thames Water set trigger levels for the OCUs at levels which meant that failing OCUs were not detected and remedied properly because those trigger levels were too high. They also say that the trigger levels were not used to initiate any process when they were exceeded.

461. As set out in the Experts' Joint Statement, Mr Peirson's view is that the monitors on the OCUs have not been used with adequate regard to setting suitable alarm levels, with the exception of the two new large OCUs dealing with the East and West cover and treat schemes. He says that the older systems have had trigger levels in the range from 0.5 to 1.0ppm whereas on the new plant the alert levels have been set at 0.05ppm. He says that more recently, with encouragement from LBH, the limits have been reduced to 0.6 to 0.8ppm and for one system to 0.2ppm.

462. Mr Peirson refers to a limit of 0.025ppm set for OCUs at Fleetwood STW and a limit of less than 0.04ppm set for OCUs at Aberdeen STW.

463. He says that H_2S testing is a good indicator for routine weekly testing but the evidence shows that Thames Water's routine testing has not detected a number of incidents of failing abatement plant. He says that the success of using H_2S trigger levels relies on

setting appropriate limits and he considers that Thames Water have been reluctant to review and justify appropriately low alarm concentrations. He also criticises Thames Water for not being proactive in carrying out olfactometric testing to confirm the effectiveness of OCUs, either after remedial action or when H_2S levels have approached or exceeded the trigger levels.

464. Dr McIntyre considers that the odour monitoring in respect of the OCUs, using target outlet H_2S trigger levels to initiate action, is an appropriate way to proceed. In relation to olfactometric testing he says that the general view within the water industry up until 2000 was that olfactometeric testing was expensive and imprecise and that the use of H_2S measurements was more precise, cheaper and could be deployed on a regular basis to provide information on odour. He considers that it was entirely reasonable for Thames Water to rely on the established testing regime with H_2S on a monthly or fortnightly or weekly basis. He said it was known from the late 1990s that overloading of biological OCUs could result in continuing good removal of H_2S but poor removal of other odorous components resulting in poor overall odour abatement efficiency. He says that this appears to be what happened on several occasions in the past at Mogden STW.

465. These limitations were, Dr McIntyre says, then recognised in 2002, following the first OdourNet survey and annual olfactometric and H_2S testing were initiated. He says that until 2002 the main indicator used for the odour control units was an approximate 95% reduction in H_2S from inlet to outlet. Following the upholding of the abatement notice, he says that these trigger levels were then set at 1.0ppm in the odour management plan provided to LBH. Dr McIntyre's view is that, over time, the trigger levels have been reduced as set out in correspondence with LBH. He says that the setting of trigger levels is an iterative process and it is important to set the trigger levels recognising the potential onset of an odour problem. Equally he says that it is important not to set the initial level at such a value that it generates many false alarms. His experience of the process is that an initial provisional trigger level is tried for a period and its performance is then reviewed so that the level can then be adjusted if necessary. He says this is what appears to have happened at Mogden STW.

466. Odour monitoring at Mogden STW appears to have started in earnest after the abatement notice served on Thames Water by LBH on 19 July 2001. That abatement notice referred to a nuisance: "*arising from the release of malodorous gases detectable outside the process boundary including Hydrogen Sulphide, Mercaptans and all other gases associated with, and as a by-product of, the processing and treatment of sewage.*" In the end that notice led to an appeal and an order by consent in Brentford Magistrates' Court dated 8 June 2005.

467. By that order the abatement notice was varied and replaced by requirements set out in the schedule to the order. Amongst the matters in that schedule were:

"*2. To carry out weekly tests of all odour abatement plant, including biofilters and bioscrubbers, to maintain records of the results of such teats for at least 24 months, and to provide copies of such records forthwith upon request by [LBH]. Such tests shall be*

for hydrogen sulphide and carried out with a meter of at least 1 ppb (part per billion) resolution for outlet concentration measures.
3. To carry out at least annually olfactory performance tests on all odour abatement plant, including biofilters and bioscrubbers and to maintain records of the results of such tests for at least 24 months...
...
8. Provide a copy of the Works Odour Management Plan (OMP) and on a continuing basis supply within 30 days copies of revisions to this plan.
...
13. The OMP shall include trigger/action levels in respect of (a) hydrogen sulphide emissions from bioscrubbers and biofilters and (b) sludge volumes in the PSTs. ...
14. The OMP shall also include proposals for regular odour monitoring at suitable locations at the site boundary and for trigger/action levels in respect of measured hydrogen sulphide concentrations at such locations. ..."

468. Subsequently Thames Water provided odour management plans to LBH. In the version in June 2005 it provided for boundary monitoring at section 3.4.1 and OCU monitoring at section 3.4.2. That monitoring was to be carried out on a weekly basis using a Jerome Hydrogen Sulphide analyser. There was a provision for trigger levels of 0.5ppm H_2S at the main pumping station and 1.0ppm H_2S at the imported sludge, thickening plant, pasteurisation plant and transfer pumping station OCUs. If any of those trigger/action levels were exceeded, this was to be reported to LBH the next working day. It stated that olfactory performance tests on each OCU would be carried out annually. In revision 6 to that document dated December 2007 the trigger level was amended, as stated above, with figures of 0.2ppm to 1.0ppm for all plant and 0.05ppm for the new plant at the East and West inlet works.

469. In his witness statement Mr Gardner explains that the trigger levels adopted in June 2005 were derived by considering historic performance of OCUs and their specified performance levels and were set in conjunction with LBH's Environmental Health Officers. He says that in late 2007 a number of these trigger levels were revised downwards at the request of LBH and because the relevant OCUs were consistently performing below the trigger level.

470. In principle the purpose of the trigger level must be to avoid situations in which there are undesirable emissions of odour from the OCUs. As a result there should be a correlation between the H_2S trigger levels and the stage at which emission of odour exceeds acceptable levels. The evidence, including that of Mr Gardner, shows that the trigger levels were first set in June 2005. There does not appear to have been a detailed analysis to consider the relationship between H_2S trigger levels and odour emissions. Dr McIntyre in his evidence on Day 16 confirmed that the setting of trigger levels is an iterative process in which an initial provisional trigger level is set and trialled and adjusted if necessary. He said that process would take two to three months or in other cases it would take a year if not longer. It depends on the frequency of the measurements and the trends that can be identified in those measurements.

471. In this case there appears to have been no reaction by Thames Water when the sludge reception OCU was showing very substantial emissions of 100,000 odour units as detected by OdourNet's testing in 2005 and yet as shown by Mr Peirson's analysis at paragraph 21.5.48 of his main report the outlet H_2S concentrations were only 0.24 – 0.34ppm. It is also of concern that regularly H_2S emissions were in excess of the trigger level of 1.0ppm for the Sludge Reception OCU, as set out in table 21 to Mr Peirson's main report but this does not seem to have led to any action by Thames Water. As Dr McIntyre says in his main report at paragraph 4.1.99, it was reasonable for Thames Water to rely upon the established testing regime with H_2S. However he says that it had been known from the late 1990s that overloading of biological OCUs, in particular, could result in continuing good removal of Hydrogen Sulphide but poor removal of other odorous components, resulting in poor overall odour abatement efficiency. He says that these limitations in Hydrogen Sulphide testing were then recognised at Mogden STW in 2002, following the survey for the First OdourNet Report and that annual olfactometric and Hydrogen Sulphide testing was initiated.

472. On the basis of this evidence I do not consider that Thames Water acted reasonably in the way in which they set trigger levels prior to 2007 in those cases where, despite H_2S concentrations being below those trigger levels, there were still excessive emissions of odour from the OCUs. By 2002 it is apparent that Thames Water had realised that olfactometric testing was necessary to capture odour emissions in addition to emissions of Hydrogen Sulphide. In those cases where I have found that there were failures in respect of the OCUs then I consider that the Claimants are justified in their contention that Thames Water have failed to take adequate account of the limitations of Hydrogen Sulphide testing and have failed to define suitable trigger levels for the OCUs. In addition, as identified above, Thames Water have failed to utilise the odour monitoring equipment on the OCUs in those circumstances where the H_2S concentrations have been in excess of the trigger levels but this has not led to appropriate action by Thames Water within a reasonable time.

Dispersion Modelling

473. The Claimants contend that late deployment of dispersion modelling resulted in several years delay to Thames Water developing an odour investment strategy. They also say this it delayed Thames Water being able to justify appropriate funding and therefore delayed the implementation of "best practice" odour control at Mogden.

474. The Claimants refer to the odour guidance document R9310 produced by Thames Water in May 1995 where, at Appendix 1, in detailing odour assessment it states as follows:

> "*7.1 ...Thames Water has developed a capability to carry out a wide range of odour measurement and assessment techniques include odour mapping, olfactometry, chemical analysis, atmospheric dispersion modelling and emission rate measurement. This section reviews these methods. The process coordinators for each works area will be able to help with mapping techniques and assessment of the site.*
>
> ...

> *7.6 Dispersion modelling*
> *Two of the best known atmospheric dispersion modelling methods are the Gaussian Plume model and Computational Fluid Dynamics (CFD). Thames Water R&D owns copies of two implementations of these models and are reviewing the potential for these methods for assessing the potential spread of odour from a new STW and the impact of remedial works at existing sites.*"

475. The Claimants also refer to Dr McIntyre's evidence on Day 16 when he said he could not defend a failure by Thames Water to introduce olfactometry from 2000. He said "*I think by 2000 it was established across the water industry as a technique*." He was then taken to a paper produced by a research project manager at Thames Water, Mr Phillip Scholes, who had been the author of Thames Water's Odour Guidance Document in May 1995, referred to above. In that paper he cited two odour control case studies, one at Manor Farm Sewage Treatment Works and the other at Slough Sewage Treatment Works. He referred to olfactometry and dispersion modelling and then demonstrated how both Hydrogen Sulphide based odour mapping techniques and olfactometric analysis had been used at Slough Sewage Treatment Works to identify sources of odour at the site and to monitor the improvement of site odour after remedial work.

476. Dr McIntyre was also referred to a paper which he himself had produced at a conference in 1999 with the title "*Application of Dispersion Modelling to Odour Assessment: a Practical Tool or a Complex Trap*?" In that paper he had expressed the opinion "*There is little doubt that dispersion modelling techniques have been instrumental in helping to achieve satisfactory solutions to odour problems at waste water treatment facilities. Indeed the technique represents the only practical tool which can be used to quantify, firstly, the extent of odour emissions and, secondly, the degree of abatement required to reduce the impacts to an acceptable level. My first two case studies demonstrate how models can be successfully applied, not just in a technical sense but also as a public relations tool. The third shows how dispersion modelling can be used as part of the local plan process in assessing whether land in the vicinity of the waste water treatment facility is suitable for residential development."*

477. Dr McIntyre then gave examples by reference to Wigan STW and Colchester STW and other sewage treatment works. The Claimants rely on what Mr Peirson says at paragraph 3.25 of his supplemental report where, after quoting that passage from Dr McIntyre's paper, he says:

> "*As there are a number of odour sources at Mogden which should not emit odours dominated by H2S, such as the aeration lanes and effective odour abatement plant (OCUs), I feel that dispersion modelling would be better based on olfactometric techniques than H_2S, but I fully accept that with careful interpretation H_2S could have also been used."*

478. Mr Peirson says that whilst he agrees with Dr McIntyre that Thames Water could have used H_2S based odour modelling as an alternative to olfactometry, he is not convinced that they used either of those technologies early enough in the context of such a sensitive

site to plan odour control measures proactively and to prevent Mogden STW becoming a nuisance.

479. The Claimants also refer to Mr Cranshaw's evidence where he states that Thames Water did not employ olfactometry at Mogden in the 1990s primarily because H_2S mapping provided sufficient information and was a technique that Thames Water could carry out in-house by non specialist staff. That does not appear to coincide with the view expressed by Mr Scholes in his report. The Claimants say that given the size of the works, the history of complaints and the proximity to people and also the large uncovered areas of activated sludge, olfactometry and other modelling would have been particularly appropriate at Mogden STW.

480. Thames Water submit that the general view within the water industry up until 2000 was that olfactometry was expensive and imprecise and that the use of H_2S mapping and measurement was more precise, cheaper and capable of being deployed on a regular basis to monitor odour hot-spots and odour control equipment. They accept that from 2000 the use of olfactometry became more widely recognised but submit that they acted perfectly reasonably in not adopting it until 2000. They say that, given the H_2S odour mapping studies carried out in 1989, 1990, 1994, 1997, 2000 and 2001 and given that Thames Water knew the problematic areas of the site, earlier olfactometry would not have brought any extra knowledge to them. They say that a failure to carry out olfactometry or dispersion modelling would not in of itself have prevented any nuisance at Mogden STW and therefore does not disclose a cause of action.

481. As has been set out above, Thames Water approached questions of odour control at Mogden STW from the point of view of H_2S measurement and modelling. In doing so I have no doubt that up to 2000 they were acting consistently with the general practice of water companies. However from 2000 onwards it is clear that the disadvantages of H_2S monitoring and modelling had become clear, not only to other water companies but also to those involved in considering such issues in relation to large sewage treatment works within Thames Water, such as Mr Scholes. In such circumstances I consider that at least from 2000 Thames Water should have implemented more regular olfactometry and dispersion modelling techniques as an aide to ensuring that odour emissions were minimised, using it in conjunction with H_2S testing and mapping techniques.

482. It was only in 2002 that they approached OdourNet and this appeared to provide the impetus for Thames Water to use olfactometeric techniques in response to the abatement notice. In a number of cases H_2S testing did not lead Thames Water to identify problems with the plant or processes. I consider that another cause for Thames Water not properly controlling or abating odour emissions was their failure to use olfactometeric techniques and dispersion modelling in conjunction with H_2S testing so as to avoid unnecessary excessive odour emissions from elements of the plant.

The Points of Negligence in respect of Odour

483. In the light of the findings set out above in relation to particular items of plant I can now deal with the individual Points of Negligence.

Particular of Negligence 3: Although aware of odour complaints about MSTW from at least 1989, Thames Water failed and neglected to have a formal and adequate long/term odour management and investment strategy to deal with odour from the site in 1990 or thereafter.

484. The Claimants say that the odour experts agree that certainly until 1999 there was no long-term odour investment strategy but they disagree about the position from that date. The claimants refer to Mr Kingdon's evidence that when he arrived at Mogden in February 2000 there was no formal odour management strategy in place.

485. The Claimants say that it was only with the odour management plan dated 22 January 2003 that there was anything described as a plan although that document was a collection of other documents and was not adequate. The claimants say that it was only in the assembly of the Strategic Business Plan for the AMP4 period in 2004 that there were the first signs of a coordinated strategy.

486. The Claimants disagree with Thames Water's submission that it is only in recent years since 2002 onwards that odour has been seen as a separate and distinct issue requiring major engineering solutions rather than small scale treatment of "hot spots". They say that Dr McIntyre in his evidence on Day 16 where he thought it was just before the AMP2 period in 1994 that water companies were beginning to look at formalised strategies and that by 1994 anybody reading Mr Scholes' document would realise that a plant-level strategy to address odour problems would be needed at sites where there were such problems.

487. The Claimants also refer to the monograph on best practice produced by the Chartered Institution of Water and Environmental Management ("CIWEM")in April 1998 on odour control. It was stated that "*odour problems at an existing site should be anticipated, and action should not be delayed until a serious complaint or an Abatement Notice is received.*"

488. The Claimants rely on Mr Peirson's view that companies, particularly Northumberland water and Severn Trent took a more proactive attitude to tackling odour nuisance in the 1990's as referred to in paragraphs 3.8 and 3.9 of his main report. He also says that given the scale of Mogden STW and the long history of odour complaints and taking account of the strategic approach taken with regard to odour by other sewage utility companies it would have been best practice for Thames Water to have been more proactive in developing an odour policy or strategy for Mogden STW and other Thames Water works during the 1990s.

489. The Claimants say that the effect of not having a long-term odour management and investment strategy was that there was no realisation of the extensive works needed at Mogden STW until 2002 to 2003; which led in turn to a failure to source funding during

the relevant AMPs, a failure to understand and avoid odour problems and carry out a programme of works. The Claimants say that this therefore led to or contributed to the odour nuisance to the claimants from 1999 to date.

490. Thames Water say that this Particular of Negligence is not on its own sufficient to constitute an allegation of Allen negligence. Any omission "*to have a formal and adequate long/term odour management and investment strategy*" would not by itself have prevented any relevant odour nuisance. The claimants must show where this allegation leads, and the only way it appears to lead is into impermissible capital works.

491. In any event, Thames Water say that they did have an adequate long-term odour management strategy in place in and after 1989, starting with the WRc reports in 1989 and 1990. They refer to what Mr Cranshaw and Mr Kingdon say in their witness statements. Thames also rely on what Dr McIntyre says in his report when he expresses the view that Thames Water adopted a measured, pragmatic and logical approach to dealing with odour problems at Mogden STW having regard to the size, age and complexity of the site and the resulting cost and that Thames Water took "*an active approach to developing an odour strategy for MSTW*."

492. I accept that Thames Water started to consider issues relating to odour from the time of the 1989 Abatement Order when they engaged WRc who provided the reports referred to above. There was then consideration on a number of occasions of the odour impact of particular pieces of plant but the focus of attention by Thames Water was on specific projects to comply with new statutory requirements such as the UWWTD and the regulations concerned with pathogens in sludge used, in the end, for agriculture. My general impression is that emphasis was not placed on odour reduction measures until 1999 at the earliest, with matters developing in the applications for funding in the AMP periods.

493. It is evident from the CIWEM monograph of April 1998 that, by then, water companies were being encouraged to establish major sources of odour formation and release at sewage treatment works so that the most cost-effective control strategy could be developed. I accept Mr Peirson's evidence that other water companies such as Severn Trent and Northumbrian Water had policies in relation to odour earlier in the 1990s. I would have expected Thames Water, as a reasonably competent operator of Mogden STW to have had more focus on odour as an aspect of policy at Mogden STW from at least 1999 than is evident from the documents. In this respect I consider that Thames Water did fall short of the required standard and to that extent the particular of negligence is made out.

494. I deal below with in Particulars of Negligence 1 and 2 in relation to the applications for funding during the AMP periods. It is evident that Thames Water sought funding for odour measures at other sites in the AMP2 period and for Mogden in the AMP3 period. In those circumstances I do not consider that any further plans would have assisted Thames Water in obtaining funding. Nor do I think that the particular failings which I

have found might have been avoided by such a plan to the extent that they were not avoided as a matter of proper maintenance and operation of Mogden STW.

Particular of Negligence 4: Thames Water failed and neglected to prevent odour from the MSTW becoming a nuisance to those living and working in the surrounding area

495. The Claimants refer to the Schedule of Failings on which I have made findings, as set out above. They rely, in particular, on matters of housekeeping, the digesters and storm tank cleaning. They say that these matters demonstrate that, far from making a strenuous effort to avoid odour nuisance being caused to the Claimants, Thames Water has failed to prevent odour nuisance and was negligent in failing to do so. They say that this is confirmed by the operational review carried out by Ms. Eccles in July 2003 and by the email from Mr Robin Clarke on 26 February 2004 when, in relation to his site inspection on 17 February 2004, he said "*unfortunately my observations are that collectively we are failing/falling well short of "best practical means*". The Claimants say that whilst in his witness statement he sought to say that he was overemphasising the position, this was in fact a true reflection of the position at Mogden STW at the time.

496. Thames Water submit that neither this Particular of Negligence nor Particular of Negligence 5 adds anything to the allegations of Odour Negligence in Particulars of Negligence 8 to 27. Thames Water deny that they were negligent under this Particular of Negligence for the reasons set out below when dealing with Particulars of Negligence 8 to 27.

497. In any event, Thames Water submit that they exercised all reasonable care to avoid an odour nuisance and adopted a measured, pragmatic and logical approach to dealing with odour problems at Mogden STW having regard to the size, age and complexity of the site and the resulting cost and Thames Water acted reasonably in their provisions for management and control of odours at Mogden STW. They rely on the evidence of Dr McIntyre at paras 3.1.8 to 3.1.10 and 4.1.19 of his main report.

498. I consider that, for the reasons set out above, Thames Water failed to conduct operations at Mogden STW with all reasonable regard and care for the interests of others in relation to some but not all of the allegations made by the Claimants. In particular, in respect of the following items of plant Thames Water failed and neglected to prevent odour from the Mogden STW becoming a nuisance to those in the surrounding area:

(1) Permitting skips containing material from the screenings to be left uncovered and not removed efficiently;
(2) Placing grit on the hard standing on the West side works to dry out;
(3) Failing to maintain, operate or replace the system to clean the storm water tanks effectively;
(4) Failing to maintain or replace the necessary pumps, pipework and valves to allow proper emptying of the storm tank hoppers;

(5) Failing to maintain or replace the scrapers and scum removal processes for the PSTs/SSTs.

Particular of Negligence 5: Thames Water failed and neglected to make any, or any suitable provision, to avoid odour from MSTW from becoming a nuisance to those living and working in the surrounding area.

499. The Claimants say that Thames Water failed and neglected to avoid odour becoming a nuisance at Mogden STW. They refer to Ms Eccles' operational review in July 2003 and Mr Clarke's email of 26 February 2004 referred to above and also to Ms Eccles' email of 19 February 2004 raising concerns about the management of maintenance and saying "*The importance of the delivery of maintenance at Mogden does not seem to have sunk in*".

500. The Claimants say that whilst Mr Peirson accepts that Thames Water made progressive and substantial progress in odour reduction, this was in response to the 2001 Abatement Notice and in several cases the improvements have not been sufficient to control nuisance. In particular they refer to the excessive use of storm tanks and long periods of retention of sewage in them; the large area of open PSTs and SSTs on the East side, combined with excessive sludge retention in them; ineffective or inefficient odour control units; the inlet works and the sludge digesters.

501. The Claimants say that Thames Water were negligent in failing to avoid odour becoming a nuisance in relation to these matters and this led to an odour nuisance to the Claimants from 1999 to date.

502. Thames Water repeat the submissions which they have made in respect of Particulars of Negligence 4 and submit that they exercised all reasonable care to avoid an odour nuisance.

503. I consider that, for the reasons set out above, Thames Water failed to conduct operations at Mogden STW with all reasonable regard and care for the interests of others in relation to some but not all of the allegations made by the Claimants. In particular, in respect of the following items of plant Thames Water failed and neglected to make suitable provision to avoid odour from Mogden STW from becoming a nuisance to those in the surrounding area by:

(1) Failing to have a proper system for monitoring and dealing with inlet sewage septicity;
(2) Allowing excess flows to the storm water tanks by failing to increase the flow to full treatment by using chemically assisted settlement;
(3) Failing to carry out proper operation, monitoring and maintenance of the OCUs, including failing to act reasonably in setting OCU trigger levels for OCUs;
(4) Failing to carry out consistent olfactometric tests or dispersion modelling.

Particular of Negligence 6: Thames Water treated the MSTW in the same way as any other sewage treatment works rather than having special regard to its situation in the middle of a densely populated area.

504. The Claimants say that Thames Water did not have regard to the fact that Mogden STW was a sewage treatment works in the middle of a densely populated area. The Claimants say that, as explained by Dr Spillett, the policy of Thames Water in terms of odour management in 1989 was that there should be no significant smells discernable to residents beyond 800 metres for a works boundary. This policy changed but the Claimants say it was not an appropriate policy to apply at Mogden STW given the close proximity of housing to the works, some being less that 100 metres away. In any event they refer to the OdourNet November 2002 report which included complaints which originated from 2 kilometres from the works.

505. The Claimants rely on Mr Peirson's evidence relating to Particulars of Negligence 4 and submit that Thames Water have, in many areas of operation at Mogden STW, fallen short of the best practice standards which were appropriate in the extremely sensitive location which Mogden is situated.

506. Thames Water say that they were well aware of the proximity of housing to the very substantial STW at Mogden but that, in all the circumstances and given the obligations they were under, there was little they could rationally do about it. They say that it was not the case that Mogden STW was treated in the same way as any other STW and refer to Dr McIntyre's main report at para 4.1.22 [D1/3/41]. They say that this was apparent from their unsuccessful pre-AMP attempts to obtain funding and the specific reports obtained by Thames Water starting with the WRc Reports in 1989 to 1990.

507. I consider that in relation to the matters which I have identified under Particulars of Negligence 4 and 5 Thames Water failed to treat Mogden STW having special regard to its situation in the middle of a densely populated area.

Particular of Negligence 7: Thames Water failed and neglected to provide the rigorous odour control measures that are necessary for a sewage treatment works in the middle of a densely populated area

508. The Claimants say that Thames Water failed to provide rigorous odour control measures necessary in the middle of a densely populated area. They rely on what Mr Peirson says in respect of Particulars of Negligence 4 and 5. They say that, contrary to Dr MacIntyre's assertion, Mogden STW was not treated as a special case from 1992 onwards and refer to a document produced by Thames Water in September 1992 entitled "*Large Sewage Treatment Works Strategy - Brief for Scoping and Costing of Schemes*". The Claimants rely on Mr Peirson's evidence that he would have expected Thames Water to have used the most advanced techniques to investigate the causes of off site odour impact such as those deployed by Severn Trent and the full range of techniques described in Appendix 7 of the 1995 Internal Guidance R9310 produced by Thames Water.

509. Thames Water repeat their response to Particular of Negligence 6 and say that they were well aware of the proximity of housing but that, in all the circumstances, there was little they could do about it. They say that they made unsuccessful pre-AMP attempts to obtain funding and refer to reports obtained, starting with the WRc Reports in 1989 to 1990.

510. I consider that in relation to the matters which I have identified under Particulars of Negligence 4 and 5 Thames Water failed and neglected to provide the odour control measures necessary for a sewage treatment works in the middle of a densely populated area.

Particular of Negligence 8: Thames Water failed and neglected to deal properly or at all with the problem areas identified in a report in September 1990 by WRc "An investigation of odour problems at Mogden Sewage treatment Works and Perry Oaks Sludge Treatment Works" (UC 885) and to implement the recommendations of a further report of October 1990 (UC 887); save those in relation to gas leaks from the sludge digesters."

511. The Claimants contend that Thames Water failed to deal with the problem areas which were identified by WRc in their report in September and October 1999. The Claimants say that this included a recommendation that the use of the storm tanks should be minimised. This was not fulfilled and the storm tanks were operated in a manner which has caused odour.

512. Thames Water say that they properly and reasonably dealt with all the problem areas identified in the WRc report. They say that the Claimants initially accepted that the recommendation relating to gas leaks from the sludge digesters had been implemented by Thames Water, though they have changed their position on this. They say that a recommendation that the use of the East side storm tanks should be minimised during periods of dry weather was also implemented.

513. In any event, Thames Water submit that, insofar as the WRc report required Thames Water to undertake new capital works, any allegation based on a negligent omission to carry out such works is non-justiciable. They also say that for the Claimants to rely on their case in respect of the digesters, they need permission to amend this Particular of Negligence to delete its last clause. However they say that if such an application were to be made, it would not be opposed, subject to the usual costs consequences.

514. I consider that Thames Water failed and neglected to deal properly with the recommendation that the use of the East side storm tanks should be minimised during periods of dry weather in that they allowed excess flows to the storm water tanks because they failed to increase the flow to full treatment by using chemically assisted settlement.

Particular of Negligence 9: Thames Water failed and neglected to carry out any or any adequate olfactometry and dispersion modelling in respect of the MSTW until 2002.

515. The Claimants contend that, as set out in Appendix 1 of Thames Water's Odour Guidance document R9310 produced in May 1995, Thames Water should have carried out olfactometry and dispersion modelling prior to 2002. In particular they say that olfactometry was fairly well established in the late 1990s.

516. The Claimants say that there are a number of odour sources at Mogden STW which do not emit odours dominated by H_2S, such as the aeration lanes and the OCUs. They rely on Mr Peirson's evidence that dispersion modelling would be better based on olfactometric techniques than on H_2S readings although he also accepts that with careful interpretation H_2S readings could also have been used. The Claimants say that whilst Thames Water did carry out H_2S mapping at Mogden STW it was used for troubleshooting and for rectifying the most odorous sources of odour. The Claimants say that, as Mr Peirson explained, there was no modelling which would provide the opportunity to evaluate odour impact during the night as well as the day and therefore prove a more comprehensive assessment that H_2S sampling and mapping.

517. In terms of olfactometry the Claimants say that Mr Cranshaw's evidence that H_2S mapping could be done in-house whilst olfactometry was seen as an expensive and unfamiliar technology does not seem to be borne out by the evidence which showed that Thames Water had carried out olfactometric analysis at four sewage treatment works in 1991 to 1992. The Claimants rely on Dr MacIntyre's written paper where he said that the "*only practical tool which can be used to quantify, firstly, the extent of impact of odour emissions and, secondly, the degree of abatement required to reduce the impacts to an acceptable level*" was dispersion modelling. They also refer to his evidence on Day 16 that olfactometry would have complemented the H_2S mapping and that H_2S modelling does not give the complete odour picture. He said that H_2S would give you an indication of where the major sources of odour were and where improvements needed to be made in terms of operation, in order to reduce the level of odour emission.

518. Whilst the Claimants accept that Mr Peirson agreed with Dr Macintyre that Thames Water could have used H_2S based odour modelling as an alternative to olfactometry, although not as good, they point out that Mr Peirson said that he was not convinced that Thames Water used either technology early enough in the context of such a sensitive site so as to plan odour control measures and prevent Mogden STW from becoming a nuisance.

519. The Claimants submit that given the size of the works, the history of complaints and proximity to people and large areas of activated sludge, olfactometry and odour modelling would have been particularly appropriate at Mogden STW.

520. Thames Water deny that they were negligent as alleged under this Particular of Negligence. They say that the general view within the water industry up until 2000 was that olfactometry was expensive and imprecise and that the use of hydrogen sulphide mapping and measurements were more precise, cheaper and capable of being deployed on a regular basis to monitor odour hot spots and odour control equipment. Thames Water accept that from 2000 the use of olfactometry became more widely recognised, but

they submit that they acted perfectly reasonably in not adopting olfactometry until 2002. They say that the sources of odour at Mogden STW were generally well known and measurements of hydrogen sulphide were being made on a continuous basis by fixed and portable monitors from 2000. They rely on the evidence of Dr McIntyre at paras 4.1.24 to 4.1.29 of his main report. In any event, they submit that there was little point in carrying out complex and expensive odour modelling until the sludge digester and sludge handling improvement projects had been completed.

521. Thames Water say that, given the H_2S odour mapping studies carried out in 1989 (G1/9/27), 1990 (G1/12/44), 1994, (G1/24/243) 1997 (G2/67/644), 2000 (G3/86/895) and 2001 (Goodlake G4/143/1258), and given what they knew more generally about the problematic areas of the site, it is difficult to see what earlier olfactometry would have brought by way of extra knowledge to Thames Water. They submit that it is unrealistic to say that olfactometry would have brought money from Ofwat enabling Thames Water to carry out major works to the storm tanks or PSTs, in the light of the matters set out above in respect of Particulars of Negligence 1, 2(a) and 2(b). Thames Water say that they knew that use of the storm tanks could cause odour before OdourNet reported as shown by their apology to the residents in June 2001 about storm tank use. Thames Water submit that, as a result, there was no point in doing olfactometry on storm tanks unless there was a real prospect of covering them and abating the odour and they refer to the evidence of Mr Peirson on Day 13.

522. Thames Water also submit that this Particular of Negligence does not disclose a cause of action in nuisance/negligence as an omission to carry out olfactometry and dispersion modelling would not in itself have prevented any nuisance at Mogden STW.

523. I consider that based on the document produced in May 1995 by Mr Scholes and Mr Woods of Thames Water's Research and Development Department which provided odour guidance, Thames Water should have carried out olfactometry from the late 1990s and certainly by 2000 and prior to 2002. I consider that the problems with the maintenance and operation of the plant and processes at Mogden STW, including in particular the OCUs, would have been more effectively dealt with if Thames Water had used olfactometric techniques and dispersion modelling.

Particular of Negligence 10: Thames Water failed and neglected to have adequate operating procedures in place to provide guidance as to the best operation and management of the MSTW to minimize odour emission rates.

524. The Claimants criticise Thames Water for not having adequate operating procedures to provide guidance to minimise odour emissions at Mogden STW. The Claimants refer to the "Best Operating Procedures" documents ("BOPs") which were produced in 1999 and 2000 but which did not say anything specific about the avoidance of odour. They say that it was only in 2002 that Thames Water produced a Site Operating Manual which contained best operating procedures in respect of odour emissions.

525. The Claimants criticise the 2002 Site Operating Manual for not stating that discharge of storm tanks should only take place when the rate of flow was 690 ml/d, for not setting out the conditions under which chemical dosing should be used and for having a number of other deficiencies. They say that it was not until 2009 that the document contained a specification of sequential emptying and filling of the storm tanks. The Claimants submit that this amounted to negligence in the period up to 2010.

526. Thames Water submit that this Particular of Negligence does not disclose a cause of action in nuisance/negligence as an omission "to have adequate operating procedures in place" would not in itself have prevented any nuisance at Mogden STW.

527. In any event Thames Water denies that it was negligent as alleged. They say that there were a number of procedures in place to ensure efficient operation of the STW process units and that throughout the 1990s the emphasis was on efficient design and operation. Although there were few direct reference to odour emission rates control in the earlier documents, those were implicit in the procedures. They say that the 2003 version of the Site Operating Manual contained detailed actions to address the risks of odour in the sections dealing with storm management, preliminary treatment and activated sludge plant. There were also references to odour within the sludge thickening area, daily check sheets and "Known Problems/Troubleshooting /Corrective Action Plans" for the thickening area and for the operation of the digesters in the 2004 Manual. Such procedures were also contained in the 2005 Site Operating Manual, section 4.10 of which dealt specifically with odour control.

528. Accordingly, Thames Water submit that adequate and appropriate operating procedures were put in place to minimise odour emission rates and they rely on the evidence of Dr McIntyre at paras 4.1.30 to 4.1.33 of his main report.

529. I consider that the 2002 Site Operating Manual contained sufficient statements on the control of odour but these were improved in the 2004 and 2005 versions of the manual. The 2002 version dealt, for instance, with odour nuisance in relation to the storm tanks at section 2.2 and the activated sludge plant at section 2.4. Whilst there were gaps in the original operational manual which were filled by later version I do not consider that Thames Water were negligent, as alleged, in failing to have adequate operating procedures in place to provide guidance as to the best operation and management of the Mogden STW to minimize odour emission rates.

Particular of Negligence 11: Thames Water failed and neglected to apply such best operating procedures as there were rigorously or at all.

530. The Claimants say that, in any event, Thames Water failed to apply the best operating practices. They say that the best operating practices referred to the fact that housekeeping checks should be completed "*wherever practicable to prevent the occurrence of problems that could reduce the operational efficiency of the works*". They say that the reference to "*wherever practicable*" is an acknowledgement that the BOPs could not be properly carried out or rigorously applied.

531. They also refer to the fact that whilst in 2004 Thames Water's best operating practices stated that ph checks should be carried out on biofilters and bioscrubbers, they were hardly ever carried out and H_2S checks were not carried out properly. In addition they say that storm tank emptying and filling procedures were not complied with and that chemical dosing was lower than recommended.

532. Thames Water deny that they were negligent as alleged. They say that there has been no failure or neglect to apply best operating procedures.

533. I consider that, as alleged by the Claimants, there were failures to carry out ph checks and H_2S checks as required by the 2004 version of the site operating manual in relation to the biofilters and bioscrubbers, as identified by Mr Peirson at sections 21.6, 21.7 and 21.8 of his main report. Where there are gaps in the records I consider that the proper inference to draw is that such readings were not taken. Further the lack of checking will, in my judgment, have contributed to the failure to pick up Thames Water's failures in the proper operation and maintenance of the OCUs, as identified above.

534. I am not satisfied on the evidence that there were significant failures in the process of filling and emptying the storm tanks in accordance with the site operating manuals. The evidence relied on by the Claimants, in particular the records from Dr Ismay put to Mr Cranshaw in cross-examination on Day 4 seem to me to evidence a failure of the cleaning and scraping mechanism, which I have already found was an element where Thames Water were at fault, rather than a failure in filling and emptying the storm tanks.

535. In relation to chemical dosing, I have seen the table contained at paragraph 136 of Mr Hibberd's main report which shows the level of dosing as 0.7 to 1.0 mg/l. He compares this with the level of dosing in the January 2007 SOM which he calculates as 2.2mg/l into the average flow of 550Ml/day and concludes that dosing has been at much lower rates than recommended in the SOM and, on the basis of a paper at the 1994 Symposium on Odour Control and Prevention in the Water Industry, much lower than that needed to prevent the release of H_2S from solution. I accept this evidence from which I conclude that Thames Water failed to carry out chemical dosing as set out in the SOM.

Particular of Negligence 11A: Thames Water failed and neglected to adequately maintain and repair or replace plant and equipment so as to ensure effective operation and prevent failures of plant and processes which consequentially had direct and indirect adverse effects on odours from MSTW in particular:
1. The primary settlement tanks – scrapers and scum control equipment,
2. Blocked pipes in the primary settlement tanks
3. The secondary settlement tanks and their bridges and scrapers
4. The blowers, air distribution system and aeration domes,
5. The storm tank emptying, mixing and cleaning systems,
6. Blocked pipes in the storm tank drainage system.
7. Odour abatement equipment.

536. The Claimants say that Thames Water have failed to maintain and repair or replace plant and equipment. The Claimants rely on various matters which have been set out in the schedule of failings on which I have made findings, and in particular, the scrapers and scum control equipment on the PSTs, blocked pipes in the PSTs, the SSTs and their bridges and scrapers, the blowers, air distribution system and aeration domes, the storm tank emptying, mixing and cleaning systems, the blocked pipes in the storm tank drainage system and the odour abatement equipment.

537. The Claimants say that the failure to maintain, repair and replace plant and equipment at Mogden STW amounted to negligence which has led to or contributed to odour nuisance at Mogden STW.

538. Thames Water deny that they were negligent as alleged in this very widely drafted Particular of Negligence. Thames Water accept that, as with any sewage treatment works, there were failures of equipment from time to time. Thames Water say that their approach to maintenance and repair was in line with that adopted by other water companies.

539. Thames Water also refer to procedures which they had in place to react to and identify the causes of breakdowns or failures, and measures to implement repairs. Records of maintenance schedules and reactions to breakdowns and repairs were held on the MAXIMO database. Any equipment/plant malfunction would be identified by site personnel, who would address and resolve the problem if it was within their capabilities. If not, then a procedure was initiated either to involve in-house maintenance/engineering personnel to attend to the issue, or an external term-contractor would be contacted to come to site and deal with the problem. Depending on the nature and seriousness of the cause, the problem could be rectified within a few days. Exceptionally, if new parts and equipment were required, it could take up to a few months to secure appropriate replacements, because the parts were often bespoke. They refer to the evidence of Dr McIntyre at paras 4.1.35 to 4.1.39 of his main report.

540. Whilst I consider that Thames Water are correct in saying that there are bound to be failures in plant and equipment at a complex sewage treatment plant and whilst I accept that Thames Water had in place the MAXIMO database to deal with this, there were failures, as set out in my findings above when Thames Water fell short of their duty properly to operate and maintain items of plant and machinery. In relation to the particular allegations made by the Claimants I consider that there were the following failures:

(1) Failing to maintain, operate or replace the system to clean the storm water tanks effectively;
(2) Failing to maintain or replace the necessary pumps, pipework and valves to allow proper emptying of the storm tank hoppers;
(3) Failing to carry out proper operation, monitoring and maintenance of the OCUs;
(4) Failing to maintain or replace the scrapers and scum removal processes for the PSTs/SSTs.

Particular of Negligence 12: Thames Water failed and neglected to install adequate odour monitoring equipment in a timely manner.

541. The Claimants say that whilst the installation of fixed hydrogen sulphide monitors at the site boundary in 2000 was innovative and went beyond good practice, they rely on Mr Peirson's evidence that there should have been hydrogen sulphide odour monitors on the outlets of all OCUs to provide continuous and automatic monitoring of treated air. His view, as stated in his supplementary report at paragraph 3.43, is that whilst automatic monitoring is not essential if suitable alternative manual checks are carried out in a conscious manner, the ability to monitor OCU plants seven days a week is very beneficial in such a sensitive location and would be considered best practice.

542. Thames Water deny that they were negligent as alleged in this Particular of Negligence. Thames Water say that they took timely steps to install odour monitoring equipment. They refer to the fact that the first fixed hydrogen sulphide monitor was installed at Mogden STW at the East side in February 2000 at a time when it was very rare for such monitors to be installed at sewage treatment works and say that, as Mr Peirson accepted on Day 13, this monitoring was "innovative" at the time. Thames Water also refer to the evidence of Dr McIntyre that they took unprecedented steps to install odour monitoring equipment. They also point out that four additional monitors were subsequently installed at the site by July 2001.

543. In addition, Thames Water says that they carried out regular walkover surveys with hydrogen sulphide monitors and, from 1999, carried out regular performance monitoring of the odour control units on the site.

544. They also say that since the installation of the new sludge treatment process in 2005 and the recent covering and treating of the storm tanks, inlet and primary tanks, permanent hydrogen sulphide monitors have been installed on the outlets of the OCUs and are recorded by the site SCADA system. They refer to the evidence of Dr McIntyre at paras 4.1.40 to 4.1.43.

545. It is clear that Thames Water, as accepted by Mr Peirson, were in the forefront in installing fixed hydrogen sulphide monitors at the site boundary in 2000. As Mr Peirson says, automatic monitoring is not essential if suitable alternative manual checks are carried out in a conscious manner. It was initially this method which was adopted by Thames Water but not carried out properly. If it had been then there would have been no need for automatic monitoring. Whilst I accept that the ability to monitor OCU plants seven days a week would have been very beneficial at Mogden STW, I do not consider that Thames Water were negligent in not doing so.

546. In any event, I accept that since the installation of the new sludge treatment process in 2005 and the recent covering and treating of the storm tanks, inlet and primary tanks, permanent hydrogen sulphide monitors have been installed on the outlets of the OCUs and are recorded by the site SCADA system.

547. In the circumstances I do not consider that Thames Water failed and neglected to install adequate odour monitoring equipment in a timely manner.

Particular of Negligence 13: Thames Water failed and neglected to maintain any odour monitoring equipment in proper working order.

548. The Claimants say that whilst periodic failures are to be expected, they refer to Mr Peirson's evidence that from the records there were several periods of negative value or unchanged concentrations from week to week, suggesting faults with monitoring equipment. The Claimants rely on what Mr Peirson says in his supplemental report, that occasional breakdowns are not critical provided suitable steps are taken to mitigate the effects by making manual checks and by ensuring that the monitoring equipment is repaired promptly. He says that the OCU monitoring records do not show that this has been done.

549. Thames Water deny that they were negligent as alleged in this Particular of Negligence. They rely on the evidence of Dr McIntyre who, they say, is very familiar and experienced with the selection, use and maintenance of odour monitoring equipment. They say that Dr McIntyre has inspected the records of odour monitoring data recovered for the boundary monitors and considers that they are reasonable. They say that the Jerome H_2S monitors functioned well and that, apart from regular replacement of filters on those monitors, all other maintenance was carried out by an annual return-to-base manufacturer service which normally takes 6 weeks and that the monitors on the outlet of the OCUs on the site were no less reliable, in terms of data capture, than any other similar installations in the UK Water Industry. They say that no monitoring equipment is foolproof and there will always be some periods when data is not recorded due to equipment malfunction. Accordingly, they submit that they took all reasonable measures to maintain odour monitoring equipment and keep it in proper working order. They say that no monitoring equipment is foolproof and there will always be some periods when data is not recorded due to equipment malfunction, as set out in the evidence of Dr McIntyre at paras 4.1.44 to 4.1.48 of his main report.

550. Mr Peirson's evidence is that there were several series of negative values or unchanged concentrations from week to week and he says that this suggests that there were faults with the monitoring equipment which were not acknowledged and acted upon. However, Dr McIntyre says that on his review the records of odour monitoring for the boundary monitors appeared reasonable and that the reliability of the monitors on the outlets of the OCUs complied with general UK standards.

551. Whilst I am certain that there were some instances when the monitors on the OCUs did not perform properly, I am not persuaded that there is anything on the records which would show that the conduct of Thames Water fell below the required standard. Accordingly, I do not consider that Thames Water were negligent in failing to maintain any odour monitoring equipment in proper working order.

Particular of Negligence 13A: Thames Water failed and neglected to adequately utilise any such odour monitoring equipment as has been deployed.

552. The Claimants criticise the trigger or alert levels which have been set for the odour monitoring equipment. Whilst in relation to hydrogen sulphide boundary monitors they accept that Thames Water have adopted a pragmatic approach, they consider that for the OCUs a trigger level of 1.0ppm H_2S was too high. Further they say that even when H_2S limits exceeded 1.0ppm no action appears to have been taken as a result. They rely on Mr Peirson's evidence that Thames Water have not set or justified appropriate H_2S trigger levels for some of the OCUs.

553. Thames Water deny that they were negligent as alleged in this Particular of Negligence. They say that the purpose of the on-site fixed monitors was to enable site personnel to take readings from the monitors when odour complaints were received so that a patrol could be initiated at the relevant area of the site in order to investigate the potential source of the odour. The monitors also enabled an investigation of possible on-site causes to be made when an agreed trigger level was exceeded. With regard to the odour monitoring undertaken in respect of performance of the OCUs on the site, they say that the monitoring results were used against target outlet hydrogen sulphide levels to take appropriate action to remedy any problem and that trigger levels were set for the monitors on the outlet of the more recent OCUs. They say that when these were exceeded an alarm was flagged on the SCADA system, and personnel were despatched to investigate. Accordingly, Thames Water say that they took all reasonable measures to utilise its monitoring equipment properly and they rely on Dr McIntyre's main report at paras 4.1.49 to 4.1.52.

554. As set out above I consider that Thames Water did fail and neglect to utilise odour monitoring equipment adequately in that they failed to act reasonably in setting OCU trigger levels for the OCUs.

Particular of Negligence 14: Thames Water failed and neglected to provide adequate and/or effective odour abatement plant for MSTW.

555. The Claimants criticise the OCUs and say that they were not performing adequately. The details of their allegations are set out in the schedule of failings on which I have already set out my findings.

556. Thames Water deny that they were negligent as alleged in this Particular of Negligence. They say that they did provide adequate and effective odour abatement plant. They refer to the monitoring records for the OCUs and say that these indicate that they performed well and effectively for the most part as set out above. They say that Dr McIntyre has carried out a detailed analysis of the performance of the OCUs and has also carried out dispersion modelling of OCU odour emissions to assess the likely off-site odour impact of the odour emissions during periods when the OCUs were overloaded due to sludge backlogs. They refer to the modelling and say that it shows (text at D1/3/57, contours at D4/AM17/1439-1443) that in 2002 aggregated odour from all the sludge handling OCUs

would have affected properties on the East side of Harvesters Close, properties to the North and East of Arnold Crescent and properties around Harlequin Close/Whitton Dene, together with a few properties at the western end of Beaumont Place/Mogden Lane; in 2003 only a few properties in Whitton Dene/Harlequin Close would have been affected; in 2005 a small number of properties to the North-East of Arnold Crescent, around Harlequin Close and in the Western half of Beaumont Close would have been affected and in 2008 no properties outside Mogden STW were affected.

557. Thames Water say that this modelling establishes the limited odour impact of the OCUs on the Claimants as a whole even if all the odour from the sludge handling OCUs was as a result of negligence by Thames Water. Further Thames Water submit that, insofar as the Claimants contend that additional odour abatement plant should have been installed, this is non-justiciable.

558. I consider that, as set out above, Thames Water did fail and neglect to provide adequate and/or effective odour abatement plant for Mogden STW in relation to the OCUs.

Particular of Negligence 15: Thames Water failed and neglected to maintain the odour abatement plant that did exist properly.

559. The Claimants say that Thames Water have not adequately maintained the OCUs that were installed at Mogden STW. The particular allegations are dealt with within the schedule of failings on which I have set out my findings above. The Claimants criticise Thames Water for the lack of olfactometric testing prior to 2002 and for carrying out no olfactometric testing of OCUs in 2006. They rely on Mr Peirson's evidence that Thames Water did not retest failed plant after remedial measures were carried out and say that Thames Water's approach to OCU monitoring and testing has contributed to long periods of inefficient or inadequate performance of OCUs which has contributed to elevated odour emissions from OCUs resulting in offsite odour.

560. Thames Water deny that they were negligent and say that they maintained the OCUs properly. They refer to their detailed submissions in respect of each OCU which I have considered above. They rely on the evidence of Dr McIntyre and say that he does not consider that Thames Water failed or neglected properly to maintain the OCUs at Mogden STW although he accepts that there were certain periods when Thames Water were aware that OCUs (the PFT OCUs, the sludge reception OCU, the sludge thickening building OCU and sludge pasteurisation OCU) were not performing and that, perhaps with the benefit of hindsight, remedial action could have been initiated earlier. They rely on Dr McIntyre's main report at paras 4.1.87 to 4.1.93 and submit that it was necessary to conduct proper investigations to arrive at appropriate solutions and that is something that can take some time.

561. I consider that, as set out above, Thames Water did fail and neglect properly to maintain the odour abatement plant in relation to the OCUs.

Particular of Negligence 16: Thames Water failed and neglected to impose a suitable testing regime for odour abatement plant. Such a testing regime would require at least weekly tests with a hydrogen sulphide meter or gas indicator tubes and annual olfactometry tests.

562. The Claimants say that Thames Water failed to impose a suitable testing regime for the OCUs. They say there was a lack of olfactometric testing prior to 2002, that it only became part of the testing regime after the Abatement Notice in 2005 and there was no olfactometric testing in 2006. They say that plant that had failed on testing was not subject to retesting and that the weekly testing regime was inadequate. They rely on Mr Peirson's evidence in paragraph 16.8 of his main report that a failure to impose a suitable testing regime has made a material contribution to the offsite odour impact.

563. Thames Water deny that they were negligent and say that from 1999/2000 regular performance tests on the odour abatement plant were carried out by site operatives. They say that these were initially on a monthly basis but the frequency was increased to weekly in 2001 but that unfortunately some records have been lost, particularly in the earlier periods, and they refer to the surviving records at bundle K4/3.

564. Following the first OdourNet survey of 2002 Thames Water say that annual olfactometric surveys of the entire site has been carried out on an annual basis, apart from one year, 2005. Accordingly, they submit that they did impose a suitable testing regime for the odour abatement plant and rely on Dr McIntyre's main report at paras 4.1.94 to 4.1.97.

565. There are two aspects to this allegation of negligence. First whether Thames Water did or should have carried out weekly H_2S tests and, secondly, whether they did or should have carried annual olfactometry testing. In relation to H_2S testing the records are incomplete and those records which exist and have been disclosed show Mr Adrian Wallis carrying out tests on five days from 1 November 2000 to 18 September 2001; Mr Barry Wyeth carrying out tests on three days between 25 September 2001 an 18 October 2001; various people or unidentified persons carrying out or recording "weekly odour control unit monitoring" tests at irregular and generally infrequent intervals from 29 October 2001 to 21 April 2005 and then more frequent "weekly odour control unit monitoring" testing sheets, particularly in 2007 and 2008.

566. A witness statement was put in from Mr Barry Wyeth who has unfortunately died. His evidence was that prior to 2001 the H_2S monitoring was carried out by Mr Adrian Wallis and that from September 2001 to July 2008 it was either he or Mr Dave Taggart who carried out the testing. From 2008 he says that the testing was carried out by Mr Darren Cronc. He says that, unless the testing was carried out by someone else, he carried out H_2S testing of the inlet and outlet of the OCUs as part of his weekly routine and submitted a written record to the Team Leader and Process Controller. He says that whilst infrequently testing may not have been carried out, where gaps exist in the records it is likely that this occurred because records were not retained rather than that readings were not taken. Mr Wallis says that it was only after the Odour Strategy Group was formed in late 1999 that attention turned to H2S levels which were not being monitored

by Thames Water. It was only in early 2000 that a Jerome H_2S meter was acquired and he says that from 2000 to September 2001 he carried out weekly checks on the inlet and outlet of the OCUs using that meter. He said that he agrees with what Mr Wyeth says in his statement. Mr Taggart also provided a witness statement in which he said that he had been responsible, with others, for measuring H_2S on the OCUs from the end of 2004 onwards and that before that date there was a dedicated person who did it. He was not called.

567. I have seen the records and read the evidence from Mr Wyeth and Mr Taggart. I note that the Claimants say that, in respect of the evidence of Barry Wyeth and David Taggart, given the incorrect description of pH testing in Mr Wyeth's statement and the faults reported in Dr Ismay's inspections and in disclosure documents, those witnesses are describing the ideal situation at Mogden STW, not what actually occurred.

568. I have come to the conclusion that the monitoring was not carried out regularly in the period between November 2000 and April 2005. The evidence which has been provided does not show a consistent monitoring regime being carried out in that period.

569. In relation to olfactometric testing, as stated above, I consider that Thames Water should have instigated olfactometric testing by at least from 2000 as an aide to ensuring that odour emissions were minimised. I also consider that they should have but failed to have an annual olfactometric test carried out in 2006.

570. The failure to have the appropriate H_2S and olfactometric testing carried out would have contributed to the problems with the particular OCUs which were performing badly. Such testing would have brought to light or emphasised the problems with the particular OCUs.

Particular of Negligence 17: Thames Water failed and neglected to take any, or any adequate, account of the limitations in hydrogen sulphide testing. (Reply, para. 18)

571. The Claimants submit that there are limitations on H_2S testing and that it was only after the 2002 OdourNet report that Thames Water had a proper understanding of the odour issues at Mogden STW.

572. The Claimants also rely on Mr Peirson's evidence, in his supplementary report at paragraph 3.81, where he expresses concern that, despite H_2S monitoring procedures having been in place since 2000, the testing regimes failed to detect a series of plant deteriorations, under-performances and failures that were only detected during olfactometric testing carried out from 2002 onwards.

573. Thames Water deny that they were negligent and say that it was entirely reasonable for them to rely upon the established testing regime with hydrogen sulphide on a monthly/fortnightly/weekly basis. They say that the limitations in hydrogen sulphide testing were recognised in 2002, following the first OdourNet survey, and annual

olfactometric and regular hydrogen sulphide testing was initiated and they refer to Dr McIntyre's main report at paras 4.1.98 to 4.1.101.

574. I consider that, as Dr McIntyre says in his report at paragraph 4.1.99 it was known from the late 1990s that overloading of biological OCUs in particular could result in continuing good removal of hydrogen sulphide but poor removal of other odorous components. In Dr McIntyre's case he became aware of this in 1997/1998. I consider that, until the First OdourNet Report in 2002 Thames Water did fail and neglect to take any, or any adequate, account of the limitations in hydrogen sulphide testing when given the information produced by Mr Scholes and certainly by the late 1990s they should have been aware of it. In those circumstances, I consider that this failure to have olfactometric testing carried out in 2000 to 2002 contributed to the failures to operate and maintain the relevant OCUs in that period leading to odour being caused.

Particular of Negligence 18: Thames Water failed and neglected to define any suitable and justified trigger levels for investigation or rectification work if high odour or hydrogen sulphide levels were detected.

575. The Claimants submit that there were no trigger levels prior to September 2001 and that only an informal level of 1.5 ppm was used between 2001 and 2005. From 2005 to 2007 they say there were levels of 1ppm or .05ppm for the main pumping station bio-filter but that it was only in 2007 that work was done to justify trigger levels based on OCU performance and that this led to some levels being revised downwards in 2007. They rely on Mr Peirson's evidence in paragraph 3.86 of his supplemental report that the consequences of inappropriate trigger levels have contributed to failing OCUs not being detected at an early stage so that remedial works could be undertaken and that this has resulted in avoidable contributions being made to off-site odour impact.

576. Thames Water deny that they were negligent and say that prior to 2002 the main indicator used by Thames Water for the odour abatement plants was an approximate 95% reduction of hydrogen sulphide from inlet to outlet. Subsequently, following the upholding of the 2001 Abatement Notice in 2004, the trigger levels were set at 1 ppm for the outlet levels in the odour management plan agreed with LBH. They say that trigger levels were also agreed for the site ambient hydrogen sulphide monitors.

577. They point out that as recorded in the Odour Management Plans in respect of Mogden STW, over time the trigger levels have been reduced. They refer to Dr McIntyre's view that the setting of trigger levels is an iterative process at first. They say that it is important to set the triggers at a level which recognises the potential onset of an odour problem; equally it is important not to set the initial level at such a value that it generates many false alarms. It is normal to set an initial provisional trigger level that is trialled for a period, and its performance/functionality then reviewed and the level adjusted if necessary. They say that this is what happened at Mogden STW. Accordingly, Thames Water submit that they acted properly and reasonably in setting relevant trigger levels and they rely on Dr McIntyre's evidence in his main report at paras 4.1.102 to 4.1.105.

578. As I set out above, on the basis of the evidence, I do not consider that Thames Water acted reasonably in the way in which they set trigger levels prior to 2007 in those cases where, despite H_2S concentrations being below those trigger levels, there were still excessive emissions of odour from the OCUs. In those cases where I have found that there were excessive emissions despite H_2S being within the trigger levels then I consider that the Claimants are justified in their contention that Thames Water have failed to define suitable trigger levels for the OCUs.

Particular of Negligence 19: Thames Water failed and neglected to carry out any, or any adequate, ferric chemical dosing of the sewers draining into sewage or (waste waters) draining into MSTW and the internal recycles of liquors.

579. The Claimants say that there is evidence that influent sewage entering Mogden STW was septic and they rely on Mr Hibberd's evidence that the ferric dosing carried out was low at 1mg/l and that 10 mg/l would be required in the summer.

580. Thames Water deny they were negligent as alleged in this Particular of Negligence. They say that there is no evidence to suggest that the influent sewage entering Mogden STW was septic and say that, typically, septic sewage is associated with rising mains and not large Victorian gravity sewers. Thames Water rely on the evidence of their process expert, Mr Ratcliff, that large gravity sewers have sufficient hydraulic grade to ensure that the sewage is re-aerated. They say that they have carried out ferric dosing of the East and West influent flows since 2000 for the purpose of dealing with any septicity associated with sludge liquor returns, reducing the odour potential of the sludge in the PSTs, and binding dissolved sulphide in the anaerobic digesters.

581. They say that dosing the whole influent flow to a sewage treatment works is very rare and that the cost makes the practice prohibitive. Dosing, they say, is usually carried out at odour hot spots in the network and typically on long transfer rising mains. They rely on Mr Ratcliff's evidence that this continuous dosing policy was very unusual, but say that it shows Thames Water's commitment to try to control the odour emission rates across Mogden STW. Thames Water say they did install a sludge liquor permanganate dosing facility and operated it for a short while in 2003 but it was not very effective and they rely on Mr Ratcliff's evidence at section 4.1 of his main report that dosing the whole influent flow or the sludge liquors is very rare. He says that for influent flow 3mg/l chemical dosing is required to tie up 1 mg/l of dissolved sulphide so that the average dose of 1mg/l is low but, in his opinion, sufficient to cope with low levels of dissolved sulphide (septicity).

582. In any event, Thames Water submit that, as stated by Mr Hibberd, adequate dosing is of such financial significance that it would impact significantly upon the allocation of resources to Thames Water and hence is non-justiciable.

583. As set out above, I have concluded that there were periods when the inlet stream into Mogden STW was septic in the period of August and September of each year until the inlet works were covered in the period up to early 2008. Also I have found that there

appeared to have been no proper system for monitoring and dealing with inlet septicity in the period up to and including September 2007 and I do not consider that Thames Water acted in a reasonably competent manner in the way they dealt with this problem. As a result I came to the conclusion that Thames Water were negligent in this respect and that their negligence meant that odours were emitted from the inlet works in August and September each year up to September 2007.

584. In those circumstances, I consider that Thames Water should have carried out an adequate scheme of ferric chemical dosing of the waste waters draining into Mogden STW so as to avoid the effect of septicity on odour during August and September each year until September 2007. Thames Water did carry out some ferric dosing and whilst the cost may have been more to carry out the level of ferric dosing necessary during those Summer months I do not consider that this falls within the area of issues which are non-justiciable. Such chemical dosing was part of the proper operation of Mogden STW and the additional cost would be part of the work necessary to operate and maintain the existing plant.

585. I therefore conclude that the Claimants are correct in their contention that Thames Water's failed and neglected to carry out adequate ferric chemical dosing of the waste waters draining into Mogden STW.

Particular of Negligence 20: Thames Water failed and neglected to:-
(a) install automatic storm tank emptying and washing equipment in the storm tanks; and/or
(b) have in place an effective system of storm water return pumping to maximise the rate of emptying or storm tanks.

586. The Claimants rely on the 2003 Odour Management Plan which identified that sewage could be stored in the storm tanks for long periods before the flow was returned to treatment and that "*The storm tank cleaning is inadequate and odorous sludge is left on the bottom of the tanks after emptying…. Due to the sludge age odour problems are created in the entire process stream*". They say that automation of the storm tank operation was proposed in 2001 but not included in the final scheme. They rely on Mr Hibberd's evidence as to the effect of not having an automated system and say that whilst Amajets come into operation once emptying has started, they do not always prevent sludge within the storm tanks going septic. They rely on Mr Hibberd's evidence that between September 2007 and September 2009 on average 68% of storm tanks were producing odours and delays in cleaning the tanks and hoppers increased the odour levels by 28%.

587. The Claimants say that there was no effective system of storm water return pumping to maximise the rate of emptying the storm tanks prior to, at least, December 2008 and that the system currently in place is not constantly applied. They say that, whilst the evidence of Mr Williams and Mr Gardner set out the ideal system, that system was only introduced, if at all, from about 2008. They say that the fact that there were faults with the Amajets in 2009 does not excuse the failure by Thames Water.

588. Thames Water submit that this allegation is non-justiciable but, in any event, they deny this Particular of Negligence. They say that the storm water return system is manually initiated so that, after a storm event, the operators in the Mogden STW control room identify opportunities to return storm water to the East side treatment stream when the flow on the East side reduces below 450Ml/d. They say that the operators look to empty those tanks which have filled first and have had the greatest stored storm water retention. They submit that the allegation that they should have automated the system would, as Mr Hibberd accepted on Day 14, have had to be part of a capital works project, although he optimistically asserted that it would have qualified for funding as part of the UWWTD proposal in AMP2.

589. Prior to the installation of the Amajets Thames Water say that the sludge was removed by scrapers and, after emptying, any residual storm sludge was manually flushed out with final effluent. They rely on Mr Ratcliff's view at section 4.2 of his report that the storm tank cleaning and emptying equipment was in line with other large sewage treatment works in the UK. Thames Water point out that since 2002, the storm tank scrapers have been sequentially replaced with Amajet mixers which aerate and mix the stored storm water during the emptying process so as to clean the storm tanks, resulting in a brushed finish to the tank.

590. Thames Water say that Mr Hibberd's complaint about a "relaxed" programme of introducing Amajets is non-justiciable as it relates to a capital project.

591. In relation to the installation of automatic storm tank emptying and washing equipment in the storm tanks, Thames Water first introduced Amajets in the storm water tanks in Project 50WC which was approved in May 2002. This followed a number of reports in and after 1990.

592. In the 1990 WRc report it was stated that the main odour problems at Mogden STW were associated with digester operations but that further problems were caused by regular use of the storm tanks and "*insufficient cleaning of these tanks after emptying*". The report also said that one or more of the storm tanks were always in operation and that "*those recently emptied contain debris.*"

593. In the further WRc report which contained recommendations for odour control it was stated that storm tank use during dry weather flow should be reduced to a minimum and "*improvements implemented for tank cleaning, removal of solids from the tank bases prior to storm water emptying, for example.*" In particular, in section 2.2 it stated this about the East side storm water tanks: "*Additional odour problems would be caused if solids remaining in the storm tanks are exposed during emptying. It is recommended that the sludge and debris be scraped out whilst still under supernatant cover.*"

594. On 14 September 1999 Ian Crane wrote to Alan Crump and said that "*maintenance of all storm water tanks must improve*" and so must "*speed of repair to facilitate returning of storm sewerage with the tanks being scraped to minimise odour problems.*"

595. On 8 December 1999 in Mr Adrian Wallis' updated action matrix he said that, in relation to storm tanks, the odour issue was the "*length of time required to drain storm tanks*". He said that it now took 14 hours each by pumping only. He said that mechanical scrapers were not now Best Practice. He proposed action to improve storm tank drain system and said that Peter Glass was investigating fitting larger pump impellers. He said "*fitting of Amajets cost prohibitive.*"

596. In Thames Water's summary of work which could be carried out to reduce the odour generated by the storm tanks, produced on 13 July 2001, they proposed installation of tank washing pumps for half of the tanks. They said that the ultimate level of odour reduction would be provided by covering the storm tanks and providing odour control units but would require a very large initial investment.

597. Thames Water's Mogden Odour Study dated 21 December 2001 contained recommendations to reduce the likelihood of odour and this included Amajet cleaning and increased storm return capacity on tanks 1 and 5.

598. Thames Water's document dated 22 March 2002 Mogden Odour Study Further Work proposed a number of options at a total cost of £7.7m. Those options included storm tank control system modification, uprating of the return pumps and improving the cleaning system which, in due course, became part of Project 50WC.

599. In the Mogden Process Review of 30 August 2002, Thames Water identified necessary improvements in the operation of the storm tanks, scrapers and flushing mechanisms. In January 2003 Black and Veatch produced a technical specification for Project 3MYD which included additional work to clear the storm tank sludge hoppers.

600. The universal view of the Thames Water witnesses was that there were major problems with the scraper system. That must have been evident for some time and would lead to sludge being left on the bottom of the tank. I consider that from the late 1990s Thames Water should have been carrying out the replacement of the scraper system with something like the Amajet system which was later adopted. Knowing that the existing system failed properly to clean the sludge left behind in the storm tanks, I consider that Thames Water should have instigated a proper replacement system which should have been in place by about 2000.

Particular of Negligence 20A:
(a) Thames Water failed and neglected to reduce the periods when the storm tanks were in use from 1999 onwards. In particular, although works under the AMP2 UWWTD improvement scheme were designed to achieve a Flow to Full Treatment (FFT) of 810 thousand cubic metres a day (tcmd) the maximum FFT was reduced to 690 tcmd sometime after the UWWTD scheme was commissioned. This reduction, while apparently supported by the Environment Agency for river quality purposes, was occasioned by the negligent design of the improvement scheme. Paragraph 11 of the Group Statement of Case will not be relied on. This negligent design, and the

failure to remedy the same, was the main reason for the reduction to 690 tcmd and the continuing failure to reduce storm tank use.
(b) The said design was negligent because, at the 810 tcmd FFT,
(i) the completed works as designed could not meet the 1mg/l ammonia standard,
(ii) the completed works as designed resulted in effluent with high suspended solids,
(iii) the completed works as designed resulted in solids loss due to overloaded Final Settlement Tanks (FST).
(c) The design was deficient because of:
(i) Inadequate FST provision, inadequate sludge return rates, inadequate aeration capacities, and
(ii) inadequate primary tank performance (PST).
(d) As part of the UWWTD scheme, the Defendants should have provided additional FST capacity, improved activated sludge return rates, improved aeration capacity, and improved PST performance.
(e) The said deficiencies were primarily caused by:
(i) An excessive overflow rate on the FSTs
(ii) inadequate and/or ineffective chemical treatment to the PST
(iii) inadequate aeration in the Activated Sludge Plant
(iv) inadequate sludge return rates
(f) The aeration and return activated sludge rate deficiencies are believed to have pre-existed the UWWTD scheme. In attempting to increase the hydraulic capacity, the UWWTD scheme should have, but did not rectify these deficiencies.
(g) The design deficiencies resulted in the subsequent operation of MSTW requiring flows to be capped at or around 690 tcmd (8 m3/sec). This resulted in much more frequent filling of the storm tanks and fewer opportunities to empty the tanks than would have been the case with an FFT of 810 tcmd. As a result, storm tanks use and the associated odour nuisance were not reduced.

601. The Claimants say that although the UWWTD Scheme was designed to achieve Flow to Full Treatment of 810 ml/d, the maximum Flow to Full Treatment was reduced to 690 ml/d sometime after the UWWTD Scheme was commissioned and they allege that the design was negligent.

602. The Claimants allege that the UWWTD Scheme failed because there was solids loss from the FST and the design provided that, if there was a failure, chemical dosing could resolve the problem. As a result they say that chemical dosing should have been used to overcome the shortfall in PFT capacity. In addition the Claimants say that Thames Water should have used chemicals in the final settlement tanks as they are currently doing. They say that as a result of failing to use chemically aided settlement the hydraulic capacity of the works was too low, meaning that there had to be excessive use of the storm tanks.

603. The Claimants say that Thames Water should have dealt with the inadequate Flow to Full Treatment capacity by commissioning capital works well before 2009 and those capital works should have included the conversion of the East side circular PSTs to FSTs as is part of the East side enhancement project 7H9G.

604. Thames Water deny they were negligent as alleged in this Particular of Negligence and rely on the contentions set out above as to why the design was non-negligent. In any event, Thames Water submit that the allegation that Thames Water omitted to design the UWWTD works to a particular specification is non-justiciable because it is, in effect, an allegation that Thames Water omitted to carry out capital works by providing more FSTs by a particular time, which works would have reduced the storm tank usage, and thereby prevented a nuisance.

605. They submit that the use of chemically assisted settlement to improve PST Biological Oxygen Demand (BOD) and solids removal performance at high flows of 690 to 810 Ml/d was an acceptable design approach and rely on Mr Ratcliff's report at section 4.3 para. 56.

606. Thames Water say that the Claimants' allegation that the completed works could not meet the Environment Agency's summer consent requirement of 1mg/l ammonia at 810 Ml/d Flow to Full Treatment is denied. They say that the 1mg/l condition was based on a median value and nearly all the EA samples were below the yearly consent conditions and hence Mogden STW easily achieved the summer consent requirements between 2000 and 2002 when, from time to time, it was operating at a Flow to Full Treatment of 810 Ml/d. They rely on Mr Ratcliff's table of final effluent compliance data in his revised further supplemental report which Mr Hibberd, in his evidence on Day 14, agreed with as data.

607. Thames Water say that, after an initial discussion with Shelley Thomas on 15 November 2002, at some time during December 2002 the Environment Agency agreed that the Flow to Full Treatment should be reduced to 650 Ml/d and subsequently to 690 Ml/d to avoid high level of solids discharging to the river.

608. Thames Water deny that the completed works as designed resulted in effluent with high suspended solids and say that a suspended solids parameter did not form any part of the UWWTD consent. They accept that between 2000 to March 2002 there was intermittent high suspended solids loss during periods of high influent flow, which resulted in the operational SSVI rising above 80ml/g but say that during that period Mogden STW still complied with its BOD consent conditions which is closely related to suspended solids and that this was at a time when Mogden STW was operating at a Flow to Full Treatment of 810 Ml/d.

609. Thames Water say that the operational SSVI rose above the design level of 80ml/g because of a back up of sludge in the upstream PSTs which resulted in limited BOD and suspended solids removal, which in turn resulted in the downstream Activated Sludge Plant batteries having to operate with a higher mixed liquor to ensure complete nitrification and exceeding the design MLSS concentration of 3000mg/l which meant that the plant was vulnerable to solids loss during high influent flow rates. They say that once the sludge backlog was cleared from the PSTs by the permanent installation of drum thickeners in 2003, their operators were able to control the MLSS at or below the design

MLSS level and the plant would have been able to treat 810Ml/d and achieve an acceptable effluent solids performance but in December 2002 the Flow to Full Treatment was limited to 690Ml/d.

610. As stated above Thames Water deny that the design was deficient because of inadequate FST provision and say that the number of installed FSTs, as part of the UWWTD extension, was based on existing performance. Once commissioned, they say that the West Side Battery D Activated Sludge Plant had an operating SSVI below the design of 80ml/g but that the operational SSVIs for East Side Batteries A and B and West Side Battery C had a temporary increase (between 2000 and March 2002) on their operational SSVI which exceeded the design SSVI and only this would have needed additional FST surface area to treat the required Flow to Full Treatment of 810Ml/d.

611. Thames Water deny that the design was deficient because of inadequate aeration capacities. They say that the design of the aeration system for all batteries was acceptable but that the air diffuser dome efficiency reduced over a period of years and the in 2001/2 the diffusers were nearing the end of their lifespan in a number of aeration lanes and also a number of air leaks were detected in the air distribution pipework. They say that this resulted in the need to run more aeration blowers and occasionally dose hydrogen peroxide into the discharged effluent in order to meet the 1mg/l ammonia standard. In 2003 to 2005 Thames Water say they carried out a rolling programme of aeration dome replacement and air leakage repair across the East and West Side aeration lanes and that the decision to do so via capital maintenance rather than as part of the UWWTD project was entirely reasonable. They rely on Mr Ratcliff's main report at section 4.3, paras 77 to 80.

612. Thames Water deny that the design was deficient because of inadequate PST performance and say that prior to 2001 and after 2004 the performance of the PSTs was very good but they accept, as Mr Ratcliff says in his main report at section 4.3, para. 82, that between 2001 and 2004 sludge backlogs within the PSTs on occasions rose to very high levels which resulted in very poor PST performance in terms of suspended solids and BOD removal rates.

613. Thames Water say, in summary, that there were no design deficiencies in relation to the UWWTD scheme but they based the UWWTD design on existing FST performance and reasonably expected that the Mogden STW activated sludge would maintain its excellent settling characteristics and that the activated sludge return rates were sufficient provided that the SSVI continued to be below 80ml/g. Thames Water's decision to replace the diffuser domes and repair the aeration leaks via capital maintenance rather than as part of the UWWTD project was entirely reasonable. The UWWTD design was based on existing PST performance. The performance reduced between 2001 and 2004 due to sludge backlogs in the PSTs but once the backlogs were cleared the PST performance returned to the design values.

614. It is clear that in December 2002 the Flow to Full Treatment was limited by the Environment Agency to 690 Ml/d despite the fact that the UWWTD project was

supposed to increase the Flow to Full Treatment to 810 Ml/d. With a flow of 690Ml/d it was evidently necessary to divert flow to the storm tanks which would otherwise have been treated by Mogden STW operating at 810Ml/d. This resulted in much more frequent filling of the storm tanks and fewer opportunities to empty the tanks than would have been the case if Mogden STW was operating at 810 Ml/d. As a result, storm tanks use and the associated odour nuisance were not reduced.

615. I heard evidence from Mr Peter Lloyd, called on behalf of the Claimants who until his retirement in October 2009 had worked for the Environment Agency and was involved in the change in the Flow to Full Treatment from 690 to 810 Ml/d. His evidence was that the Environment Agency became concerned about the high level of solids discharging to the River Thames at Flow to Full Treatment of 810Ml/d. He referred to a reading of a sample of effluent on 26 February 2002 when there was a pollution incident when a sample contained 793 mg/l solids compared with the more normal 25 mg/l solids. He said that this was due to high flows through Mogden STW washing the biological solids used in the activated sludge process from the final settlement tanks into the river.

616. The consent issued by the Environment Agency required in the winter period parameters of 23mg/l of BOD and 7 Mg/l of ammonia, with a Tideway Agreement requiring 11mg/l of BOD and 1 mg/l of ammonia in the Summer. However these figures are not instantaneous figures and whilst the table showing final effluent compliance in Mr Ratcliff's revised further supplemental report show that, apart from two periods there was compliance with the requirements, this did not as Mr Lloyd explained mean that there might not within the data be periods when high solids might not be recorded. It was this that led to the limit on the Flow to Full Treatment of 690Ml/d.

617. In relation to the allegation by the Claimants that this was caused by the negligent design of the UWWTD by Thames Water the data shows that in 2000 to 2002 when Mogden STW was operating at 810 Ml/d, the final effluent complied with the 1mg/l Summer ammonia standard. I now turn to the allegation that the design was deficient and resulted in effluent with instantaneously high suspended solids or solids loss due to overloaded FSTs.

618. The first allegation is that there was inadequate FST provision. The Claimants say that Thames Water should have provided additional FST capacity because there was an excessive overflow rate on the FSTs. The design carried out by Thames Water considered a number of alternative schemes. As set out in the draft project Implementation Proposal for Project 5523, four options were considered. The first (option 1) was conventional treatment with 15 additional 18m diameter FSTs. The second (option 2A) used chemical dosing and high PST hydraulic loading. That option was "*aimed at optimising the PST provision and utilises the improved BOD removal (50%) from dosing to reduce the ASP and FSTs required. At normal flows PST dosing would be curtailed.*" It used 12 additional 18m diameter FSTs. The third (option 2B), which was the one adopted, used chemical dosing and low PST hydraulic loading. That option also aimed to "improve PST BOD removal and reduce ASP provision. More PSTs allows up to 60% BOD removal. At

normal flows PST dosing would not be required." It used 8 additional 18m diameter FSTs. The fourth (Option 3) used tertiary nitrification.

619. On 2 and 10 July 1996 Dr Koodie produced memoranda in which he set out his conclusions on the number of FSTs which would be required. In the memorandum of 10 July 1996 he considered the effect of designing to an SSVI of 80ml/g, which was not considered risky, if the SSVI value for whatever reason increased to 100ml/g and the effect on the reduction in maximum flow. Whilst the predicted values were not achieved, I do not consider that Tames Water were negligent in adopting the values they did which led them to design the number of FSTs which they provided.

620. The second allegation is that there were inadequate sludge return rates. The Claimants say that there were inadequate sludge return rates which were not rectified as part of the UWWTD project. In his supplemental report Mr Hibberd referred to the 2002 Process Review at Mogden STW. He noted from that document that for Batteries C and D the Return Activated Sludge rates were 33% and 45% rather than the value assumed for the design of 60%. There is no criticism of the design value but the criticism centres on the fact that there were sludge problems and the UWWTD scheme added some 10% to the sludge production rate which Mr Hibberd says was not taken into account in the design. Mr Hibberd considers that with RAS rates of 33% or 45%, it would be necessary to have SSVI levels of 60ml/g or below to avoid sludge blanket loss, even at reduced flow rates. It is noted that for Battery D the Process Review reported that the SSVI level was 60ml/g.

621. Thames Water submit that if the SSVI values remained at or below 80ml/g the RAS rates were adequate but accept that between 2000 and March 2002 when flows were high, SSVI values rose above 80ml/g and MLSS was above 3000mg/l and there was a risk that at these values the RAS rates would not be adequate. However they submit that these were not the parameters against which the UWWTD was designed.

622. I consider that the 2002 Process Review produced in August 2002 shows the position when there were problems with the sludge stream. I am not persuaded that these problems arose from the increase in sludge production of about 10% caused by the UWWTD project. Rather, I consider that it the impact of the problems with the sludge stream which I have referred to above which caused the high SSVI values in Battery C. In those circumstances, I have come to the conclusion that the Return Activated Sludge rates were not low in that period because of any design failure in the original UWWTD scheme but were caused by matters which occurred afterwards and should not reasonably have been taken into account in the design of that scheme.

623. The third allegation is that there were inadequate aeration capacities. The Claimants say that there was inadequate aeration in the Activated Sludge Plant which was not rectified as part of the UWWTD project. Thames Water deny that the UWWTD design was deficient because of inadequate aeration capacities. They say they carried out aeration dome replacement and air leakage repair via capital maintenance rather than as part of the UWWTD project and this was entirely reasonable. In his evidence Mr Hibberd says that the condition of the aeration plant from 2000 probably until the sludge backlog was

cleared in 2005 was such that the aeration system was unable to meet the oxygen demand without standby plant and peroxide injection.

624. Again, I consider that the difficulties with the aeration system only gave rise to problems because of the sludge backlog. This meant that the blowers could not be taken out of service for planned maintenance. I do not consider that the design of the UWWTD was negligent in relation to this. Rather, the planned maintenance of the aeration system was properly the way of dealing with that system and the design should not have taken of the system other than in on the basis that the system would be maintained, as it was in 2003 to 2005.

625. The fourth allegation that there was inadequate PST performance is no longer pursued by the Claimants.

626. Accordingly, in summary I have come to the conclusion that Thames Water were not negligent in their design relating to the UWWTD scheme but that they reasonably based the UWWTD design on existing FST performance and reasonably expected that the Mogden STW activated sludge would maintain its settling characteristics and that the activated sludge return rates were sufficient provided that the SSVI continued to be below 80ml/g. Thames Water's decision to replace the diffuser domes and repair the aeration leaks via capital maintenance rather than to deal with those issues as part of the UWWTD project was entirely reasonable.

627. It follows that I do not consider that any negligence in Thames Water's design of the UWWTD resulted in the subsequent operation of MSTW requiring flows to be capped at or around 690Ml/d or caused more frequent filling of the storm tanks and fewer opportunities to empty the tanks than would have been the case with a Flow to Full Treatment of 810 Ml/d, thereby causing the associated odour nuisance.

Particular of Negligence 20B: Thames Water failed and neglected to reduce the resulting excessive use of storm tanks due to inadequate FFT capacity by:

(1) effective regular and optimised chemical dosing to assist the settlement process in the East and West side Primary Settlement Tanks (PSTs) thereby enabling lower Mixed Liquor Suspended Solids ("MLSS") to be carried in the aeration units giving lower aeration requirements and faster settlement rates thereby increasing the hydraulic capacity of the works and reducing the duration of storm tank use;

(2) effective use of chemically aided settlement to improve the settlement properties of the MLSS in the Final Settlement Tanks (FSTs) thereby increasing the hydraulic capacity of the works and reducing the duration of storm tank use.

628. The Claimants say that the UWWTD Scheme failed because there was solids loss from the FST and the design provided that if there was a failure chemical dosing could resolve the problem. As a result they say that chemical dosing should have been used to overcome the shortfall in PFT capacity. In addition the Claimants say that Thames Water should have used chemicals in the final settlement tanks as they are currently doing. They

say that as a result of failing to use chemically aided settlement the hydraulic capacity of the works was too low meaning that there had to be excessive use of the storm tanks.

629. Thames Water deny that they were negligent as alleged in the Particular of Negligence and say that the UWWTD design only specified for chemical dosing to be used on the West Side between 690 and 810 Ml/d. Rather they say that between 2001 and 2004 sludge backlogs within the PSTs on occasions rose to very high levels which resulted in very poor PST performance in terms of suspended solids and BOD removal rates. However they rely on Mr Ratcliff's evidence in his main report at section 4.4 where he points out that in the UWWTD design chemical dosing was only to be used on the West side at flows of between 690 and 810Ml/d. He also states that during 2001 to 2004 when the sludge backlogs within the PSTs rose on occasions to very high levels this would have resulted in very poor performance in terms of suspended solids and BOD removal. He says that in these conditions the addition of chemicals would have exacerbated the problem since chemical dosing would have increased sludge production and produced a very thin sludge which would have been less amenable to gravity thickening.

630. As set out above, it is clear that as part of the design of the UWWTD project Thames Water considered that where excessive flows to full treatment of above 690 Ml/d were encountered, they would use chemical dosing of the West side PSTs. It is evident that that this was an inherent part of the design of the plant. Whilst chemical dosing may have had some impact on the gravity thickening of the sludge in the PFTs I do not consider that Thames Water took reasonable steps to mitigate the impact of the high flows to full treatment by carrying out chemically assisted settlement. Thames Water do not rely on evidence of why they did not do so nor do they seek to establish when chemically assisted settlement stopped.

631. All things being equal, it seems to me that chemically assisted settlement in the PSTs would have allowed higher flows to full treatment so that there would have been less flow to the storm water tanks. I consider that Thames Water failed to conduct operations at Mogden STW with all reasonable regard and care for the interests of others in not using chemically assisted settlement in the PSTs.

632. As set out above, so far as chemical dosing of the FSTs is concerned, I am not persuaded by Mr Ratcliff's evidence that this would have had such counterproductive effects that it would not have been a solution. I accept Mr Hibberd's evidence that the additional sludge production would have been small and could have been dealt with by the steps already taken by Thames Water to increase SAS handling capacity. In my judgment, in failing to take steps to assist the FST process by chemical dosing, Thames Water fell below the standards of a competent operator of this plant. Had Thames Water carried out chemical dosing of the FSTs I consider that, on the evidence, this would have increased the hydraulic capacity of the works and reduced the duration of storm tank use.

633. On this basis I consider that Thames Water have provided no good reason why chemically assisted settlement was not used to overcome the problems which led to the use of the storm water tanks and I consider that they failed to conduct operations at

Mogden STW with all reasonable regard and care for the interests of others by not seeking to increase the flow to full treatment by using chemically assisted settlement rather than allowing excess flows to flow to the storm water tanks.

Particular of Negligence 20C: Thames Water failed and neglected to reduce the resulting excessive use of storm tanks due to inadequate FFT capacity by capital works commissioned well before 2009. These capital works should have included the conversion of the East Side circular PSTs to FSTs as the current East Side Enhancement Project (7H9G).

634. The Claimants say that Thames Water should have dealt with the inadequate flow to full treatment capacity by commissioning capital works well before 2009 and those capital works should have included the conversion of the East side Circular PSTs to FSTs as is part of the East side enhancement project 7H9G.

635. In the Experts' Joint Statement Mr Hibberd has summarised the effect of project 7H9G under which the East side circular tanks are converted from PSTs to FSTs increasing the capacity from 690 to 790 Ml/d by adding an additional 5,280 m^2 of FST area. He says that had this project been brought forward this would have reduced the number of days that the storm tanks were being filled from approximately 50% to 25% of the time, with quicker storm tank emptying because of the increase in Flow to Full Treatment. He says that the associated reductions in odour emissions from the reduced storm tank usage and the abandonment of two stage primary settlement could have been achieved at least 5 years earlier. He also says that there is no evidence that the two stage settlement process works any better than a single stage process.

636. He also says that the two stage primary treatment process increased the retention time and therefore the opportunity for septicity to develop in those tanks. He refers to a table in a November 2002 Investigation of the Mogden East side PST Odour and Flow to Full Treatment which shows the emission rate of PSTs in the UK is typically 1.9 $ou_E/sec/m^2$ surface area, with a high value being 7.5. At Mogden STW the values were 22 for the East side circular PSTs and 18 for the East side rectangular PSTs. That report referred to odour complaints leading to site investigations which, both on site visits and the OdourNet survey, identified the East side PSTs as causing a significant odour nuisance.

637. Thames Water deny this Particular of Negligence. They submit, first, that the allegation that it failed to commission "capital works" well before 2009 is non-justiciable. Secondly they say that, in any event, they were not negligent but in 2002-2004 took all reasonable steps to obtain relevant funding and to carry out the relevant capital works. They say that funding for the relevant project (Project 59HF) was not authorised by Ofwat until 2004 to 2005; that the sequential refurbishment of the existing FSTs and the conversion of the East side PSTs to FSTs started in 2007. They say that a project of this size takes considerable time to evolve and they rely on Mr Ratcliff's evidence in his main report at paras 100 to 103, that they could not have accelerated the project without significantly affecting the operation of Mogden STW.

638. Mr Ratcliff states that the UWWTD design philosophy was to build on the existing good process unit performance which included the percentage BOD removal in the PSTs of 40 to 45%. The design used this figure at flows below 690Ml/d and used 35% at flows up to 810Ml/d and Mr Ratcliff says that this high removal of BOD was ensured by maintaining a two stage primary settlement process. He considers that once the sludge backlog issue was removed in 2003, the operational SSVI value at Mogden STW would have meant that it could treat 810Ml/d. He says that the main purpose of Project 7H9G was to remove the primary tank odour source at the East side by converting the circular PSTs to FSTs.

639. He also says that it was the OdourNet reports in 2002 and 2003 that identified the East side circular PSTs as a source of odour which led to a business case to Ofwat in 2004 with funding being granted in 2005 for Project 59HF which included the decommissioning and cleaning of those circular tanks and was completed by 2008. He says that Thames Water then gained funding approval to increase the Flow to Full Treatment to 1064Ml/d and the part of the project to convert the circular PSTs to FSTs was carried out from 2007 to 2009 and the balance of the work involves the major expansion of the West side works.

640. I deal with justiciability questions below. So far as the allegation of negligence is concerned, the thrust of the complaint is that Thames Water should have started the process for funding in 1999 rather than in 2004 so that the works to take the East side circular PSTs out of service should have started 5 years earlier. I do not consider that to be correct. In the circumstances I consider that Thames Water acted reasonably in proceeding with the conversion of the PSTs to FFTs and the other work.

641. As a result, I do not consider that Thames Water were negligent in failing to carry out works to increase the Flow to Full Treatment before they did under the current Project 7H9G.

Particular of Negligence 21: Thames Water failed and neglected to provide any or any adequate covers and odour control units for the storm water tanks and primary settlement tanks.

642. The Claimants rely on Mr Peirson's evidence that given the size and location of Mogden STW Thames Water should have adopted a solution of covering the storm water tanks and the primary settlement tanks in the 1990s. Mr Peirson in paragraph 21.21 of his evidence on the Particulars of Negligence in his main report and in paragraphs 3.88 to 3.90 of his supplementary report considers that given the size of the primary settlement tanks and the storm water tanks the odour nuisance at Mogden STW can never be adequately controlled without covering them. He criticises the decision to reduce the covering of the storm water tanks to cover only two of them on the basis that covering two tanks led to 3% odour reduction not the 17% reduction envisaged.

643. Thames Water submit that the allegation that they omitted to provide covers and OCUs for the storm water tanks and PSTs is non-justiciable but, in any event, they were not

negligent. Thames Water say that they adopted a reasonable approach once the 2002 OdourNet survey identified the relevant contributions of the various process units at Mogden STW. They rely on Dr McIntyre's report at paras 4.1.106 to 4.1.108 and say that, prior to AMP 4, Ofwat would not have agreed to authorise funding for capital works involving the provision of covers to the storm water tanks or the PSTs.

644. I consider the question of justiciability below. In relation to whether Thames Water should have adopted a solution of covering the storm water tanks and primary settlement tanks in the 1990s, the first stage was the identification of those processes as being the source of an odour nuisance.

645. In summary the history of the odour problems with the Storm Tanks was as follows:

(1) Problems with odour from the Storm Tanks was identified in the 1990 WRc Reports. They recommended that the Storm Tank use during dry weather flow should be reduced to a minimum and improvements should be made to tank cleaning.

(2) In 1993 one of the main areas of concern was stated at a Customer Liaison Meeting to be storm tank operation and it was stated that improvements were in hand to improve control of storm tanks.

(3) In November 1994 Miss Dewhurst prepared an odour strategy report. She identified that a capital scheme had been completed allowing automation of storm return flows based on first flush and that a capital scheme due to be completed in 1994 would install high pressure washwater facilities.

(4) In September 1995 approval was sought for a budget to develop Project 5523, the extension at Mogden STW and this led to a draft project implementation proposal for that project in July 1996.

(5) In September 1999 Adrian Wallis reported that in respect of the Storm tanks, odours were generated more frequently as a result of increased flows to East side. He stated that once the new works were commissioned and the West side is taking a higher proportion of flows the situation would improve.

(6) In December 1999 Mr Adrian Wallis stated that, in relation to storm tanks and return, the odour issue was the length of time required to drain storm tanks. The proposed action was to improve the Storm Tank drain system. It was stated that fitting of Amajets was "cost prohibitive" and again said that the problems should be much reduced once the West side capital works were complete.

(7) In June 2001 Thames Water wrote to residents to explain that the main reason for the continuing odour issue appeared to be because the storm tanks had been continuously in operation since November 2000.

(8) In July 2001 Thames Water investigated work which could be carried out to reduce the odour generated by the storm tanks. In a summary on 13 July 2001 they proposed works which they said would achieve significant benefits including a scum baffle on the East side storm tank weir, relocation of the storm return so that it was not returned to the storm tanks, automation of the control for half of the storm tanks and installation of tank washing pumps for half of the tanks. They said that the ultimate level of odour reduction would be provided by covering the storm tanks and providing odour control units but would require a very large initial investment.

(9) On 21 December 2001 Thames Water produced a Mogden Odour Study which set out the likely sources of odour at Mogden STW and contained proposals for reducing that odour. In the summary of recommendations it set out options to reduce the likelihood of odour being generated rather than covering and using odour control units to deal with the consequences. In relation to the Storm Tanks the options were to carry out control modifications, introduce Amajet cleaning and increase storm return capacity on tanks 1 and 5.

(10) On 22 March 2002 Thames Water produced a further report which said that because of increased flow from higher than average rainfall, the increased frequency of use of the storm tanks was also a source of odour and they proposed a number of options at a total cost of £7.7m. In relation to the Storm Tanks the options were first, to modify the control system, uprate the return pumps and improve the cleaning system or secondly, covering and odour control of the tanks. In due course Project 50WC implemented the first option.

(11) In the First OdourNet Report in November 2002, OdourNet considered the proposed modifications to the Storm Tanks and concluded that they were likely to result in reduction of emissions from the tanks of 50%, giving an overall 8% total reduction in emissions from Mogden STW. Those improvements were carried out during 2002/2003.

(12) In the Second OdourNet Report in November 2003 they said that the modifications to the storm tanks had reduced odours by 25%, making an overall reduction of 3%. They identified further improvements for the purpose of Thames Water's submission PR04 and said that, as a minimum, application of cover and treat solutions would be required various areas including the Storm Tanks. This led to Thames Water producing in January 2004 a "PR04 Odour Control Proposal" for Mogden STW which set out work which included covering and treating the Storm Tanks which overall would reduce odour by 70.4% at a cost of £76m.

646. From a review of that process it can be seen that the problem with odour from the Storm Tanks was identified from 1990 but that until 2002 the possibility of covering and treating the Storm Tanks was not mentioned in a report by Thames Water as a possible solution. As Mr Ratcliff states and I accept, from 2002 Thames Water adopted a

measured and appropriate methodology to dealing with the problem of odour from the Storm Tanks. Prior to that, it was clear that the WRc were not suggesting a cover and treat solution in 1990 and I do not consider that Thames Water can be criticised for not considering such a scheme whilst they were making improvements to the Storm Tanks and whilst they obviously considered that the improved capacity from the UWWTD scheme would reduce the need to use those tanks. I accept that at other sites a cover and treat solution was being carried out at an earlier date than at Mogden STW. However. I am not persuaded that this shows that Thames Water were negligent in the context of the process at Mogden STW.

647. In relation to the variation to the scheme of covering and treating all the Storm Tanks to a scheme limited to two "first fill" tanks, as stated above, this was a matter where Thames Water balanced the various improvements in odour reduction and decided to carry out work to the PSTs. I do not consider that Thames Water can be criticised for this approach.

648. In relation to the PSTs, the history of odour from these tanks was as follows:

(1) An odour survey carried out in July 2001, in response to complaints, concluded that, whilst not the main source of odour, the East-side Primary and Secondary Sedimentation Tanks were another source of odour.

(2) In the Mogden Odour Study produced by Thames Water in December 2001 the summary of recommendations set out options to reduce the likelihood of odour being generated rather than covering and using odour control units to deal with the consequences. The options included modifying the East side SSTs to operate as PSTs to minimise the age of the sludge and distribute the loading to the PSTs.

(3) On 22 March 2002 Thames Water produced a further report on the Mogden Odour Study which proposed a number of options at a total cost of £7.7m. Those options included conversion of the SSTs on the East side to PSTs but this was not included in Project 50WC.

(4) In November 2002 Thames Water produced a report "Mogden East side Primary Sedimentation Investigation of Odour and Flow to Treatment Issues". It stated that recent odour complaints had led to investigations and the East side PSTs and SSTs had been identified as causing a significant odour nuisance. The report sought ways of reducing that odour.

(5) Following the implementation of various improvements at Mogden STW during 2002/2003, OdourNet produced the Second OdourNet Report in November 2003.

(6) They reported that the improvements had achieved varying levels of success in reducing odour emissions. There had been an 86% reduction in odours from the Sludge handling and treatment areas, making an overall 30% reduction. They identified further improvements for the purpose of Thames Water's submission

PR04 which would be required to reduce the level of exposure to odours experienced by local residents to an acceptable level. They said that, as a minimum, application of cover and treat solutions would be required to, among other areas, the East side PSTs and SSTs. OdourNet recommended that certain works should be carried out which they said were likely to reduce odour emissions by 65%. These included: "*Optimise the control and management of return liquors to the East Side primary tanks from the sludge handling area of the works, and adopt a robust sludge and scum removal scheme within the tanks to ensure effective removal of sludge and prevent occurrence of septic conditions.*"

(7) On 26 January 2004 Thames Water produced a "PR04 Odour Control Proposal" for Mogden STW. It set out work in the form of covering and treating the Inlet Works, Storm Tanks and Primary Treatment which would reduce odour by 70.4% at a cost of £76m.

649. Again from a review of that chronology it can be seen that the problem with odour from the PSTs was identified in 2001 and it was in the November 2003 OdourNet report that the possibility of covering and treating the PSTs. Prior to that a number of ways of minimising odour from the PSTs were considered and implemented. In this case the WRc were not suggesting any remedial work in 1990. I consider that from 2002 Thames Water adopted a measured and appropriate methodology for dealing with the problem of odour from the PSTs, including the conversion of the SSTs into FSTs and covering and treating them. I do not consider that Thames Water can be criticised for their approach to the PSTs,. Whilst I accept that at other sites a cover and treat solution was being carried out at an earlier date than at Mogden STW, I am not persuaded that this shows that Thames Water were negligent in the context of the process for the PSTs at Mogden STW.

650. As a result, I do not consider that Thames Water were negligent in failing to provide covers and odour control units for the storm water tanks and primary settlement tanks at an earlier date or, in the case of the Storm Tanks, only to cover the "first fill" Tanks initially.

Particular of Negligence 22: Thames Water failed and neglected to have adequate sludge consolidation and treatment capacity in the Works, at least before 2003.

651. The Claimants refer to the evidence of Mr Kingdon in his report of 17 July 2001 where he described the PFTs as the "Achilles heel of Mogden" and said that the process when co-settling was taking place was hopelessly overloaded and could not operate with the throughput rates required which created a back log of sludge in the works which, in turn, particularly in the secondary settlement tanks, caused a proliferation of odour as it gradually turned septic waiting to be removed from the tanks. He also criticised poor planning of the digester refurbishment scheme which created a backlog of some 30,000 m^3 of sludge in the works, with no contingency for removal of the sludge.

652. As a result the Claimants say that Thames Water failed to have adequate sludge consolidation and treatment capacity in the works at least before 2003.

653. Thames Water deny this Particular of Negligence. First, they submit that the allegation that Thames Water omitted to "have adequate sludge consolidation and treatment capacity in the Works" by a particular date is non-justiciable. Secondly, they submit that, in any event, they were not negligent and when the original decision to use PFTs was made in the early 1990s, PFTs were seen as the best technology for thickening co-settled sludges. They say that once Thames Water, in common with other water companies, recognised the performance issues associated with gravity thickening of co-settled sludge, they took entirely reasonable and pragmatic steps to remedy the problem. They say that conversion of the PFTs from operating on co-settled sludge to primary sludge was carried out in three stages so as to allow the improvements to be assessed at each stage and that it was entirely reasonable for Thames Water not to abandon expensive assets such as the PFTs without trying to make them work.

654. In relation to drum thickeners, they say that these were initially used in the UK Water Industry during the late 1990s, typically to thicken Surplus Activated Sludge and that a number of water companies trialled the technology during the late 1990s. In particular, United Utilities trialled drum thickeners on co-settled sludge at Davyhulme STW in Manchester, but they were dissatisfied with their initial performance and thereafter selected Gravity Belt Thickeners. Thames Water say that the early machines in the 1990s were small and only really suitable for small sites and that by the early 2000s drum thickeners began to become established in the market as a competitive emerging technology for mechanical thickening for both primary sludge and SAS applications.

655. They say that drum thickeners are now seen as the most cost effective solution for primary sludge mechanical thickening and that drum thickener unit throughput increased during the early 2000s and this demand increase has led to their installation on very large scale sites, including Mogden STW. They say that the replacement of PFTs with drum thickeners took from February 2002 to Spring/Summer 2005 and was a significant capital investment in Mogden STW and a substantial engineering and construction project. They refer to the fact that the new process units had to be installed into the existing sludge treatment train and then commissioned and optimised whilst Operations continued operating the existing PFTs. They rely on Mr Ratcliff's evidence in his main report at paras 104 to 111that he considers that it was perfectly reasonable for Thames Water to undertake a thorough trialling and proving exercise prior to committing to 100% mechanical thickening of the primary sludge.

656. I have considered the issue of justiciability below. In relation to the allegation of negligence, I have dealt with Thames Water's approach to sludge consolidation and treatment capacity in the works above and, in summary, have found that Thames Water were not negligent in failing to have adequate sludge consolidation and treatment capacity at Mogden STW at any stage before they did in about 2003.

657. Accordingly, I do not consider that Thames Water were negligent in failing to have adequate sludge consolidation and treatment capacity in the Works, at least before 2003.

Particular of Negligence 23: Thames Water, rather than allowing an increase in odour from the site as admitted in paragraph 42 of the Defence, should have put in place some short term contingency measures to deal with this sludge such as temporary sludge centrifuges to allow sludge to be transported off site as cake. (Reply, para.5)

658. The claimants say that, on the basis of the evidence of Mr Hibberd and Mr Peirson, Thames Water should have taken short-term contingency measures such as introducing temporary sludge centrifuges.

659. Thames Water deny this Particular of Negligence. They say that the allegation underestimates the costs and operational burden associated with such a project at Mogden STW. They say that the project would have been a massive undertaking and would have involved the installation of seven very large centrifuges running 24 hours a day and a huge increase in skip lorry movements to 35 per day. Moreover, they say that such operations could have been counterproductive because there was a substantial risk that they might generate more odour than they were trying to avert.

660. Thames Water say that they acted entirely reasonably in adopting the approach of identifying and implementing the appropriate long-term solution and that any temporary raw sludge treatment measures would have substantially increased the site's odour emission potential. They rely on Dr McIntyre's evidence in his main report at paras 4.1.109 to 4.1.113 and Mr Ratcliff's evidence in his main report at paras 112 to 116.

661. I have already considered this allegation and, in summary, have come to the conclusion that Thames Water acted reasonably in their approach to dealing with the situation which arose during Project 2CKC and it would not have been reasonable for them to have hired temporary sludge de-watering plant to reduce those stocks during 2000.

662. Accordingly, I do not consider that Thames Water were negligent in failing to have put in place some short term contingency measures to deal with the sludge backlog, such as temporary sludge centrifuges to allow sludge to be transported off site as cake.

Particular of Negligence 24: Thames Water failed and neglected to adopt an Environmental Management System such as the Eco-Management and Audit Scheme (EMAS) 1995, for MSTW by 1998 at the latest. (Reply, para. 8)

663. The Claimants rely on Mr Hibberd's evidence at paragraphs 412 and 417 of his main report where he considers that early adoption of an environmental management system would have avoided the poor quality OMPs and SOMs which both caused significant odours and failed to reduce them.

664. Thames Water deny this Particular of Negligence. They say that the water industry has always had its own internal quality systems and that no water company adopted an "Environmental Management System" such as EMAS 1995 until recently, with the onset of the Pollution Prevention and Control Regulations 2000 (PPC) permitting certain

sludge processing operations. Thames Water say that in Spring 2008 they achieved certification to ISO 14001 for their operations in respect of the sludge processing plant at Mogden STW and they refer to Dr McIntyre's evidence at paras 4.1.114 to 4.1.116 of his main report.

665. Thames Water also submit that this Particular of Negligence is not, on its own sufficient, to constitute an allegation of Allen negligence because any omission to adopt an Environmental Management System by 1998 would not by itself have prevented any relevant odour nuisance but must be linked with some substantive outcome which EMAS would have led to, which would have, itself, to be justiciable.

666. I am not persuaded that Thames Water were negligent in failing to have an Eco-Management and Audit Scheme for Mogden STW by 1998. I consider that Thames Water's Odour Management Plan which was put in place from 2003 was consistent with the guidance issued both by UK Water Industry Research and DEFRA code of practice. Whilst Eco-Management and Audit Schemes have been in place from 1993 and 1995, I do not consider that, in relation to allegations of odour, the Claimants have established that Thames Water was negligent in not having one by 1998. I note and accept Mr Gardner's evidence in paragraph 70 of his first witness statement that Mogden STW achieved ISO 14001 accreditation in Spring 2008 and that, prior to that Mogden STW was audited regularly for environmental best practice since the mid 2000s.

667. Given the particular aspect of concern related to odour management and odour prevention rather than the general requirements of an Environmental Management System such as the Eco-Management and Audit Scheme, I consider that the Odour Management Plan is of more importance.

668. In any event, I accept Thames Water's submission that any failure to have a scheme does not, in itself, give rise to a cause of action. There would have to be an allegation that the failure to have an Environmental Management Scheme meant that Thames Water failed to do something which they should have done because of the failure to have an Environmental Management System. I do not consider that the failure to have such a system in itself or to have a Site Operating Plan or odour Management Plan as a result of failing to have a system is sufficient for the court to be able to draw any inference of the effect.

669. As a result, I do not consider that Thames Water were negligent in failing to adopt an Environmental Management System for Mogden STW by 1998 at the latest.

Particular of Negligence 25: Thames Water adopted a reactive approach to odour complaints rather than a proactive approach in relation to odour from MSTW (Reply, para. 12)

670. The claimants rely on a CWIEM 1998 monograph which considered that sewerage treatment operators should be proactive. They say that Mr Peirson considered that Thames Water were only proactive after the service of the Abatement Notice in July 2001.

671. Thames Water submit that this Particular of Negligence adds nothing to the other Particulars of Negligence in respect of Odour. They deny that they were negligent for the reasons set out in relation to those other Particulars of Negligence.

672. As can be seen from the WRc Reports in 1990 onwards, Thames Water have taken steps as a result of reacting to complaints from residents. The Claimants accept that the approach was pro-active from 2001 after the service of the Abatement Notice. Whilst in the period before 2001 I consider that Thames Water's approach could generally be described as reactive, I am not persuaded that the fact that Thames Water reacted to complaints rather than taking action without there being complaints gives rise to a cause of action. The important question is what Thames Water failed to do, whether they should have acted proactively or did act reactively.

673. It follows that I do not consider that Thames Water were negligent to the extent that they adopted a reactive approach to odour complaints rather than a proactive approach in relation to odour from Mogden STW.

Particular of Negligence 26: Thames Water failed and neglected to improve odour emission standards from the works as part of the expansion process at MSTW in 1998-2000. (Reply, para. 14)

674. The Claimants rely on Mr Peirson's evidence in his main report at paragraph 26.2 where he says that there is no evidence that Thames Water took any steps to reduce odour emissions as part of the UWWTD Scheme.

675. Thames Water deny this Particular of Negligence and say that it was reasonable for Thames Water to assume that the level of odour emission increase resulting from operation of additional PSTs and activated sludge lanes would be small in relation to the emissions from the existing plant at Mogden STW, and that with modern plant (in relation to the existing plant) relative odour emission rates should be lower. They rely on Dr McIntyre's evidence in paras 4.1.117 to 4.1.122 of his main report.

676. I have not been referred to any evidence which shows that Thames Water considered the impact of odour from the UWWTD scheme when carrying out the design of that scheme. So far as the other parts of the works are concerned I have dealt with the allegations that there were failures by Thames Water and, to the extent that there was a failure, I do not consider that the issue of whether that should have been remedied under the UWWTD scheme or another means affects the position.

677. In relation to the works to the West side carried out as part of the UWWTD scheme, I would accept that by 1998, in designing a new part of a Sewage Treatment Works, Thames Water should have taken into account the odour impact of those new works. However, without there being a particular element of the design which should have been carried out differently, I cannot make a relevant finding of negligence in relation to

something that Thames Water failed to do but should have done in taking into account the need to reduce odour emissions in designing the UWWTD scheme.

678. Accordingly, I do not consider that the Claimants have made out any relevant allegation of negligence by Thames Water in relation to a failure to improve odour emission standards from the works as part of the expansion process at Mogden STW in 1998-2000.

Particular of Negligence 27: Thames Water failed and neglected to carry out an environmental impact assessment in respect of the 1998-2000 expansion which would have provided the basis of a submission in respect of odour mitigation works to OFWAT. (Reply, para. 15)

679. The Claimants say that, had Thames Water carried out an environmental impact assessment in the late 1990s they would have been in a much better position to make submissions in relation to AMP funding. They rely on Mr Peirson's evidence in his supplemental report at paragraph 3.104 that had Thames Water carried out an objective odour impact assessment in the late 1990s they would have had a very real prospect of gaining a true appreciation of the scale of the odour issues at Mogden STW and would therefore have been in a much better position to have applied for and justified funding for extensive cover and treatment solutions at an earlier stage.

680. Thames Water deny this Particular of Negligence and say that it discloses no cause of action in nuisance/negligence. They point out that there was no formal planning application for the expansion of Mogden STW as the works were deemed to be Permitted Development, and so no environmental impact assessment was required to be carried out.

681. In any event they say that it was reasonable for Thames Water to assume that the level of odour emission increase resulting from operation of additional PSTs and activated sludge lanes would be small in relation to the emissions from the existing plant at Mogden STW, and that with modern plant (in relation to the existing plant) relative odour emission rates should be lower. They rely on Dr McIntyre's evidence in paras 4.1.117 to 4.1.122 of his main report.

682. In relation to the works to the West side carried out as part of the UWWTD scheme I do not consider that the question of whether or not Thames Water should have carried out an environmental impact assessment affects the position. In general, as I have said, I would accept that by 1998, in designing a new part of a Sewage Treatment Works, Thames Water should have taken into account the odour impact of those new works. Again, though, without there being a particular element of the design which should have been carried out differently on the basis of an environmental impact study, I cannot make a relevant finding of negligence in relation to something that Thames Water failed to do but would have done had they taken into account the need to reduce odour emissions in designing the UWWTD scheme. Further, in relation to the contention that such an assessment would have provided the basis of a submission in respect of odour mitigation works to OFWAT, that it seems to me comes within the aspect of the allegations of negligence in terms of a failure to press for funding.

683. Accordingly, I do not consider that the Claimants have made out any relevant allegation of negligence by Thames Water in relation to a failure to carry out an environmental impact assessment in respect of the 1998-2000 expansion.

The law on odour nuisance

684. Before analysing the impact of the odour emissions which I have found were caused by the negligence of Thames Water it is necessary to consider the extent to which, as a matter of law, odour emissions are at law a nuisance which gives rise to the right to a remedy.

685. Thames Water refer to a passage in *Clerk & Lindsell on Torts* (19th edition) where the authors define "Nuisance" as follows:

> "***Nuisance defined*** *The essence of nuisance is a condition or activity which unduly interferes with the use or enjoyment of land. In common parlance, stenches and smoke and a variety of different things may amount to a nuisance in fact but whether they are actionable as the tort of nuisance will depend upon a variety of considerations and a balancing of conflicting interests. An actionable nuisance is incapable of exact definition, and it may overlap with some other heading of liability in tort such as negligence or the rule in Rylands v. Fletcher. Nuisance is an act or omission which is an interference with, disturbance of or annoyance to, a person in the exercise or enjoyment of (a) a right belonging to him as a member of the public, when it is a public nuisance, or (b) his ownership or occupation of land or of some easement, profit, or other right used or enjoyed in connection with land, when it is a private nuisance."*

686. I accept that, as Thames Water submitted, what might be described as a "nuisance in fact" may not give rise to an actionable nuisance. There are a number of factors which have to be taken into account, including a balance of conflicting interests.

687. Thames Water submit that one of the reasons why a nuisance in fact may not be an actionable Nuisance is that the character of the neighbourhood is such that the inconvenience complained of is not regarded as actionable in law. They referred to the well known passage in the judgment of Thesiger LJ in Sturges v Bridgman (1879) 11 Ch D 852 at 856 where in a case where a doctor had built a consulting room in his garden which had a party wall to a shop where meat was pounded in mortars obtained an injunction to prevent the nuisance in the form of noise and vibration. The Court of Appeal rejected an argument that difficulties would be caused if someone could build a house in the midst of the tanneries of Bermondsey or close to a blacksmith who had built his forge away from housing and obtain an injunction to prevent them from continuing their trade. Thesiger LJ said that whether anything is a nuisance is not to be determined merely by considering the thing itself but "in reference to its circumstances; what would be a nuisance in *Belgrave Square* would not necessarily be so in *Bermondsey*; and where a locality is devoted to a particular trade or manufacture carried on by the traders or manufacturers in a particular and established manner not constituting a public nuisance,

Judges and juries would be justified in finding, and may be trusted to find, that the trade or manufacture so carried on in that locality is not a private or actionable wrong."

688. They also refer to the following passage in the judgment of Cumming-Bruce LJ in Allen v Gulf Oil Refining Ltd [1979] 1 QB 156 at 171C to E, approved by Lord Wilberforce in the House of Lords at [1981] AC 1001 at 1013:

> *"So, in the instant case, if as a matter of interpretation of the Act it is clear that the intention of Parliament was to change the immediate environment of the village of Waterston by the construction upon the specified site immediately beside the village of a great oil refinery with jetties appropriate to the berthing of large tankers bringing in vast quantities C of crude oil, and a railway to carry the products of the refinery away overland, it would follow that Parliament had authorised a dramatic change in the neighbourhood of the village. Thereafter a complaint of nuisance by interference with the enjoyment of life in the village would on any view have to show such a degree of interference with enjoyment as exceeded such levels of noise and impurity of air as are inevitable in a neighbourhood in which oil refinery business is to be regarded as the norm. This perhaps difficult question of fact is not the same as the question whether the refinery has been constructed and operated with due regard to the application of such mechanical and chemical devices as will minimise interference with the lives of the inhabitants of the village, i.e. the question of negligence in the special sense in which breach of the duty of care is described in this context. So if it is right to hold as a matter of construction of the Act that it was not the intention of Parliament to grant the defendants a licence to invade the common law rights of the inhabitants by subjecting them to any degree of interference with their comfort and convenience by noise, vibration, or air pollution, there will still remain the question whether the complaints of the plaintiff are such as to constitute a nuisance having regard to the changed character of the environment which Parliament has authorised."*

689. I accept the principle to be derived from those decisions. The locality or neighbourhood may show that there is some inevitable nuisance in fact because of a process which has traditionally been allowed or one which has been authorised at law. However this does not mean that the mere fact that houses have been built around the boundary of the sewage treatment works at Mogden means that odour from the sewage treatment works cannot be a nuisance. It is a factor to be borne in mind in balancing the interests of the Thames Water and the Claimants as neighbours.

690. Thames Water also rely on the defence of statutory authority arising out of their duties under the WIA to the extent that such complaints are justiciable. They rely on the following passage in the speech of Lord Wilberforce in Allen v Gulf Oil Refining Ltd at 1011F where he said:

> "*We are here in the well charted field of statutory authority. It is now well settled that where Parliament by express direction or by necessary implication has authorised the construction and use of an undertaking or works, that carries with*

> *it an authority to do what is authorised with immunity from any action based on nuisance. The right of action is taken away: Hammersmith and City Railway Co. v. Brand (1869) L.R. 4 H.L. 171, 215 per Lord Cairns. To this there is made the qualification, or condition, that the statutory powers are exercised without " negligence "— that word here being used in a special sense so as to require the undertaker, as a condition of obtaining immunity from action, to carry out the work and conduct the operation with all reasonable regard and care for the interests of other persons: Geddis v. Proprietors of Bann Reservoir (1878) 3 App Cas 430, 455 per Lord Blackburn. It is within the same principle that immunity from action is withheld where the terms of the statute are permissive only, in which case the powers conferred must be exercised in strict conformity with private rights: Metropolitan Asylum District v. Hill (1881) 6 App.Cas. 193."*

691. Thames Water refer to the fact that the definition of "negligence" in this passage has twice been cited with approval by the House of Lords. First, in Tate & Lyle v GLC [1983] AC 509 per Lord Templeman at 538 and, secondly, in Dept of Transport v NW Water [1984] 1 AC 336 per Lord Fraser of Tullybelton at 359H-360A.

692. Thames Water also refer to Manchester Corp v Farnworth [1930] AC 171 on the question of whether a nuisance is the inevitable result of carrying out the functions authorised by Parliament. Viscount Dunedin said this at 183:

> "*When Parliament has authorized a certain thing to be made or done in a certain place, there can be no action for nuisance caused by the making or doing of that thing if the nuisance is the inevitable result of the making or doing so authorized. The onus of proving that the result is inevitable is on those who wish to escape liability for nuisance, but the criterion of inevitability is not what is theoretically possible but what is possible according to the state of scientific knowledge at the time, having also in view a certain common sense appreciation, which cannot be rigidly defined, of practical feasibility in view of situation and of expense.*"

693. Viscount Sumner said this at 187:

> "*... the first question is "What did the Legislature authorize?" The sections can be read as directing the use of such a plant as was originally erected or even as relieving the Corporation from liability for nuisance on proof that all due care has been used. The case becomes one of quite a simple proof. I think the condition of freedom from liability is proof of due care but not that any particular plant or user can be implied from the general terms employed. The appellants are right in saying that the Manchester Corporation Act, 1914, is not a "special Act" within s. 1 of the Electric Lighting Clauses Act of 1899, but in effect varies or excepts the operation of the scheduled clauses of that Act. What is required of them is to use all due and reasonable means and precautions to avoid a nuisance. The burden of proving that they have done so is on them.*"

694. In approaching the question of negligence in this case, the relevant principle is that Thames Water had to carry out the work and conduct the operation at Mogden STW with all reasonable regard and care for the interests of other persons, including the Claimants. If they do so then they will not be liable in nuisance for the inevitable result of operating Mogden STW taking into account what is possible in terms of scientific knowledge at the time, practical feasibility and expense. In one sense the two matters are connected. In operating Mogden STW Thames Water must do so with all reasonable regard and care for the interests of others and in deciding what is reasonable in that context, such matters as state of the art, practicability and expense are potentially relevant matters. However, in principle, the question of negligence is a matter for the Claimants to establish but the question of inevitability is, as stated in Manchester Corp v Farnworth for Thames Water to establish. I note that Thames Water would wish to reserve their position on where the burden of proof lies on inevitability should the matter go further.

Justiciability

695. Thames Water contend that a number of allegations of negligence pleaded by the Claimants as "Odour negligence" are not justiciable

Thames Water's submissions

696. Thames Water contend that a number of allegations of negligence are not justiciable following the decision of the House of Lords in Marcic v Thames Water Utilities Ltd [2004] AC 42 where Lord Nicholls of Birkenhead said this at [35]:

> "*...it is abundantly clear that one important purpose of the enforcement scheme in the 1991 Act is that individual householders should not be able to launch proceedings in respect of failure to build sufficient sewers. When flooding occurs the first enforcement step under the statute is that the director, as the regulator of the industry, will consider whether to make an enforcement order. He will look at the position of an individual householder but in the context of the wider considerations spelled out in the statute. Individual householders may bring proceedings in respect of inadequate drainage only when the undertaker has failed to comply with an enforcement order made by the Secretary of State or the director. The existence of a parallel common law right, whereby individual householders who suffer sewer flooding may themselves bring court proceedings when no enforcement order has been made, would set at nought the statutory scheme. It would effectively supplant the regulatory role the director was intended to discharge when questions of sewer flooding arise.*"

697. Thames Water accept that a parallel cause of action in nuisance for damage caused by negligent failures to maintain and operate existing assets is justiciable. They submit that, in each case, the question is: what is the nub of the allegation? If, as in Marcic the underlying allegation is that Thames Water ought to build more sewers, then such a claim will not be justiciable. They say that in the case of the allegation that Thames Water should have covered the storm water tanks, it does not matter whether the allegation is that Thames Water should have made an earlier or better case to Ofwat or should have funded them out of their own resources or should have done earlier olfactometry to make

a better case to Ofwat, all these are non-justiciable because they require Thames Water, in the words of Marcic to "build more sewers". They accept that the boundary line between justiciable and non-justiciable claims is difficult to draw and the precise label in terms of the type of expenditure may assist but will not necessarily provide the answer.

698. Thames Water also rely on what Lord Nicholls said in Marcic at [35] in relation to the enforcement provisions contained in sections 18 to 22 of the WIA. Thames Water say that the Claimants have been considering the question of inconsistency with the statutory scheme solely in the context of funding but ignore the issue of enforcement. Thames Water submit that, as Lord Nicholls said in relation to flooding, the first enforcement step under the statute is that Ofwat, as the regulator of the industry, will consider whether to make an enforcement order. Thames Water say that the existence of a parallel common law right, whereby individual householders who suffered sewer flooding might themselves bring court proceedings when no enforcement order had been made, would set at nought the statutory scheme. It would effectively supplant the regulatory role that Ofwat was intended to discharge when questions of sewer flooding arose.

699. Thames Water say that, similarly, in this case, when an odour nuisance occurs by reason of their alleged failure to comply with their statutory duty, the first enforcement step under the statute is that Ofwat, as the regulator of the industry, will consider whether to make an enforcement order. It is in the context of enforcement that the potential for inconsistency lies, in particular a potential inconsistency between Ofwat's liability and timing determinations and the court's liability and timing determinations. Thames Water submit that, as in Marcic, the existence of a parallel common law right whereby individual householders who suffered an odour nuisance might themselves bring court proceedings when no enforcement order had been made, would set at nought the statutory scheme and effectively supplant the regulatory role that Ofwat was intended to discharge when questions of odour nuisance arose as a result of the omission to construct new capital works.

700. Thames Water refer to the provisions of sections 18 to 22 of the WIA and submit that they contain a statutory mechanism by which Ofwat determines not only whether there is a contravention of any statutory requirement enforceable under s.18 ("the liability determination"), but also by when that contravention should be remedied ("the timing determination"). Thames Water submit that the potential inconsistency arises because the court is solely concerned with the position as between the Claimants and Thames Water and the court might conclude that Thames Water ought reasonably to have carried out certain necessary remedial works once it had actual or constructive notice of the problem.

701. However, Thames Water submit that Ofwat would have to consider the position, not only from the point of view of the particular Claimants, but from the much broader point of view of all Thames Water's customers who would ultimately have to pay for the relevant works. Thames Water say that, just as in Marcic there was a need for an undertaker to adopt some system of priorities for building more sewers to abate a nuisance is self-evident, so is the need for an undertaker to adopt some system of priorities for carrying out new capital works to improve the functionality of existing sewage treatment works.

They refer to the speech of Lord Nicholls at [38]: "*A fair system of priorities necessarily involves balancing many intangible factors. Whether the system adopted by a sewerage undertaker is fair is a matter inherently more suited for decision by the industry regulator rather than a court. Moreover, the statutory scheme provides a remedy where a system of priorities is not fair*".

702. Equally Thames Water submitsthat, having regard to the various statutory considerations under section 2(2A) of the Water Industry Act, Ofwat might conclude that it would not be appropriate for Thames Water to carry out the remedial works or carry it out by a particular date because, having regard to the broader considerations, it was more appropriate to defer the carrying out of the works until a subsequent asset management plan period (AMP) when Ofwat could authorise the appropriate funding.

703. Despite this, Thames Water accept that Parliament probably contemplated that Ofwat would, in normal circumstances, exclude such broader considerations where the complaint is a "low level" complaint that Thames Water had negligently failed to maintain and operate its existing assets in a reasonable manner. In that situation, Parliament might well have contemplated that both the Court and Ofwat would, or should, make the same liability and timing determinations so that it was unlikely that there would be any potential inconsistency between adjudication by the Court and adjudication by Ofwat. However, Thames Water submit that the position is very different where "higher level" matters are concerned, particularly where substantial sums of money are potentially involved in the construction of new capital works or major opex decisions like the chemical dosing. In that situation, Thames Water say that Ofwat has a duty to consider the broader interests of all Thames Water's customers, which consideration has the potential to give rise to inconsistency between the statutory scheme and adjudication by the court.

The Claimants' submissions

704. The Claimants submit that Thames Water must show that in addressing each of the Points of Negligence the decision of the court would be in conflict with the statutory scheme under the Water Industry Act 1991. They say that in the present case the court must determine whether such conflicts arise on the evidence before it which may be different from and more detailed than the evidence before the court in Marcic. They refer to the letter dated 8 August 2008 in which Thames Water dealt with the position in the event that the court determined that they had failed to take steps which they owed the Claimants a duty to take. Thames Water stated that funding would have been made available to it to take such steps whether or not Thames Water was able to raise the necessary funding through customers' bills. On this basis the Claimants say that in this case, compared to Marcic, it would not have been necessary for the cost of the capital works to fall on customers and therefore no conflict would arise with the statutory scheme in any event.

705. The Claimants rely on five Justiciability Issues which deal with aspects which they say fall outside allegations to the effect that more resources should have been committed under the regulatory framework. They refer to the distinction drawn in the First Judgment

at [143] between concerns that the court would be embarking on an exercise which conflicts with the statutory regime or matters which come within the sphere of operational matters such as cleaning and maintaining a sewer. The Claimants submit that none of the five aspects conflict with the statutory regime even if they go outside the sphere of operational matters.

706. The Claimants refer to Thames Water's statement that Parliament intended Ofwat to have exclusive jurisdiction in relation to capital works and in particular to determine the scope of such works and whether and by when the works should be carried out. The Claimants say that they accept that statement in relation to works regulated by the AMP Process. However they submit that the five Justiciability Issues relate to works to forestall or remedy negligent behaviour and are not within the exclusive province of Ofwat. They say that the essential dichotomy is not between capital matters and maintenance matters but between matters which fall outside the statutory regime which are justiciable and matters which fall within it and which are not justiciable.

707. The Claimants refer to the evidence of Mr Day who said that water companies would have the freedom to do further work on odour abatement if they felt it was the right thing to do, either from their commercial point of view because it was limiting bad publicity or that it would avoid legal exposure. As a result the Claimants say that any such work would fall outside the statutory regime. They also refer to Mr Crathorne's evidence that if a company wanted to make improvements from customer charges it would need Ofwat's permission but that there was nothing to stop companies using shareholder money to cover the costs.

708. The Claimants therefore rely on the five Justiciability Issues in submitting that the relevant matters which are the subject of the Schedule of Failings and the Particulars of Negligence are justiciable.

709. First, the Claimants submit that if Thames Water have no policy in relation to a matter in respect of which it has been found negligent, they cannot rely on a policy defence. They say that the Claimants do not have to show that Thames Water failed to perform a particular act at Mogden STW but that the question is whether Thames Water had or did not have a policy that affected Mogden STW which led to a nuisance as a result of negligence, as defined in Allen. For instance, the Claimants say that if Thames Water did not set odour standards for its sewage treatment works and the court finds that the failure to have such standards led to continuing odour then the issue is justiciable. They say that Thames Water cannot rely on general statements as to policy but must rely on specific policies in relation to odour control at Mogden STW.

710. Secondly the Claimants rely on the fact that capital works might be funded through "Capital Maintenance". They refer to Mr Day's evidence that water companies have a "large pot of money" for capital maintenance of assets and can choose to allocate that pot of money in any why they like so long as it delivers the broad overall outputs expected of it in order to maintain its assets fit for purpose. The Claimants say that in the AMP1 period it was assumed that water companies would handle odour issues as part of the

normal running of their plants which, they submit is broadly within "Capital Maintenance" as explained by Dr Spillett. The claimants say that in such circumstances there is no conflict with the statutory regime. They say that if work is necessary to forestall or remedy a nuisance and it can be funded from the "Capital Maintenance" budget and that this work should have been done to discharge Thames Water's Allen duty, it is a matter which is justiciable by the court.

711. Thirdly, the Claimants rely on management inefficiency. They refer to the definition that Ofwat gave to this term where, by way of example they said that "*where a company in fact failed to deliver an improvement in service or quality that Ofwat has assumed when setting price limits previously, this might be reflective of inefficient management by the company in question.*" The Claimants submit that if, as a result of Thames Water's negligence, odour has caused a nuisance to the Claimants and this is a result of management inefficiency the issue is justiciable regardless of whether the work in question would require capital expenditure. They refer to Mr Day's evidence where he said that in relation to Regulatory Capital Value (RCV) water companies would not be allowed to include expenditure on outputs which it should have been delivering in any case and that this element of "inefficiency" would not be expenditure which customers would be expected to finance on a permanent basis. The Claimants submit that if odour nuisance was caused through Thames Water's negligence in failing to allocate expenditure to carry out work on operational or capital items to resolve a nuisance, then this work would be something which Thames Water should have been carrying out anyway and not something that customers should be expected to finance. In such circumstances the Claimants submit that nuisance caused by management inefficiency would be justiciable.

712. Fourthly the Claimants refer to "capital efficiency". Capital efficiency is defined by Ofwat as "the efficiency of using capital expenditure to deliver outputs". In setting price limits Ofwat make assumptions that a water company will be required to incur capital expenditure over the relevant period in order to deliver a particular output such as an improvement in service. A capital efficiency occurs where that output is in fact achieved for a capital cost that is less that the amount contained in Ofwat's assumption. The Claimants submit that once capital efficiency has been achieved by a water company, Ofwat has no role in how the monies saved by that efficiency are allocated. Such expenditure, Mr Day said, would be permanently reflected in a water company's RCV unless it went over the overall capital expenditure envelope. The Claimants say that in 1995 to 2000, as appears from the evidence, Thames Water had capital efficiencies of £500m some £65m of which was allocated to sewerage services. The Claimants say that, in particular, in the context of Mogden STW, the UWWTD Scheme led to savings of at least £47m and probably £70m. The Claimants submit that in an Allen case where there is reasonable evidence to show cost savings were obtained by Thames Water, it is for Thames Water to show that the capital efficiencies were not obtained, otherwise the court is entitled to infer that such savings were obtained. The Claimants contend, in particular, in relation to the UWWTD Scheme that the adoption of Option 2B was to gain capital efficiency savings and this option led to the failure of Mogden STW to be able to comply with the discharge requirements which then caused increased use of the storm tanks and

odour nuisance. In those circumstances the Claimants say that any capital efficiency gained by Thames Water in relation to the UWWTD Scheme should have been allocated by Thames Water to odour control at Mogden STW.

713. Fifthly the Claimants rely on sums available and used for the payment of dividends to the shareholders of Thames Water. The Claimants say that Ofwat has no role in these sums used by Thames Water to pay dividends to their shareholders. They rely on Dr Spillett's evidence and submit that the question of whether profits should be paid as dividends or used for odour control works at Mogden STW is entirely a matter within the control of Thames Water. As a result the Claimants contend that if the court considers that odour nuisance has been caused to the Claimants as a result of Thames Water's negligence that could have been dealt with by works which could have been paid for from profits prior to their allocation to dividend payments, then the claims would be justiciable by the court as being outside the statutory scheme.

714. In summary the Claimants submit that claims are justiciable on a number of grounds. First, if the allegation relates to an operational matter; secondly, if the allegation could have been remedied by funds which were or should reasonably have been sought through the statutory process and thirdly, if the allegation could have been remedied by funds extraneous to the statutory scheme as set out above.

715. Before I deal with these submissions it is convenient to deal with the matters set out in my First Judgment and the evidence on the question of the funding process

The First Judgment

716. In the first judgment I dealt with the way in which the Marcic principle applied in the circumstances of the claim for Allen v Gulf Oil negligence in this case. In summary I held:

(1) At [83] that the Claimants are seeking to enforce duties which arise under section 94(1)(b) of the WIA in respect of odours from Mogden STW and/or Mosquitoes which "live and breed as a result of sewage or sewage sludge at Mogden STW and/or the plant and equipment at Mogden STW holding or treating such sewage or sewage sludge".

(2) At [120] that certain causes of action in nuisance based on negligence will exist alongside the duties under WIA .

(3) At [140] that a boundary is to be drawn between matters which would fall within the duties under s. 94(1) and are actionable solely under s. 18 and matters which are actionable apart from the existence of any statutory duty. That boundary may be difficult to draw and may depend on such uncertain phrases as matters or decisions relating to "policy" or "capital expenditure" matters or decisions as contrasted with "operational" or "current expenditure" matters or decisions.

(4) At [143] if there is negligence and if the cause of action is not inconsistent and does not conflict with the statutory scheme then there is nothing to preclude a claim being made on that basis. Policy matters are likely to lead to such inconsistency and conflict whilst operational matters are less likely to do so. It must be a question of fact and degree. Where an allegation is tantamount to requiring major plant renewal that will fall on one side of the line whilst an allegation that a filter should be cleaned will lie on the other side.

(5) At [145] that whether and to what extent any of the matters alleged give rise to a cause of action in nuisance involving the allegations of negligence will depend on the extent to which the allegation concerns policy matters or capital works such as building new or better facilities at Mogden STW rather than operational matters requiring current expenditure on matters such as maintenance.

717. In that judgement I set out in answer to issues 2 and 3 the following statements which are applicable to the general consideration of justiciability in this case:

(1) Issue 2: The Claimants are not precluded from bringing a claim in nuisance involving allegations of negligence, negligence or based on negligence under the HRA where, as a matter of fact and degree, the exercise of adjudicating on that cause of action is not inconsistent and does not involve conflicts with the statutory process under the WIA. In such a case, section 18(8) WIA enables the bringing of such claims despite the principle in Marcic.

(2) Issue 3: The claims in nuisance involving allegations of negligence, negligence and under the HRA which are not precluded are those where, as a matter of fact and degree, the exercise of adjudicating on the cause of action is not inconsistent and does not involve conflicts with the statutory process under the WIA. Causes of action based on the physical operation and/or operational management of the works are not likely to be precluded but that will depend on the facts.

718. The question which I have now to determine is whether the exercise of adjudicating on any of the claims is inconsistent with and involves conflicts with the statutory process under the Water Industry Act 1991.

719. One of the issues which has been at the forefront of the evidence and submissions of the parties is the extent to which adjudicating on any of the claims would be inconsistent with, or involve conflicts with the statutory process because of the effect of the statutory process on the funding of any work.

720. In Marcic the House of Lords received written submissions from Ofwat concerning the financial implications of carrying out work to provide sewers to overcome the flooding problems of which Mr Marcic complained. At [24] and [25] Lord Nicholls of Birkenhead said this:

> "*24. Sewerage undertakers receive no subsidy from public funds for works of this nature. The cost has to be met out of money received from customers by way of sewerage charges. But sewerage undertakers are not at liberty to fix the amount of sewerage charges at whatever amount they wish. The Director sets limits on these charges. Sewerage charges in respect of dwellings are the subject of charges schemes which require the approval of the Director: sections 142 and 143(6). In setting the limits on charges the Director proceeds on the basis that companies are expected to maintain current service levels.*
> *25. In fixing charging limits the Director balances the need to alleviate sewer flooding, the cost of doing so and the consequent increase in sewerage charges. He also has to take into account further needs such as the need for investment to meet other environmental standards set by the government, often pursuant to EU Directives, and the need to maintain the sewerage infrastructure as a whole. It seems that in the past a cautious approach has been adopted by the Director, partly because of the lack of reliable information about the scale of the sewer flooding problem and the cost of dealing with it.*"

721. Lord Nicholls then concluded as follows at [34] and [35]:

> "*34. In my view the cause of action in nuisance asserted by Mr Marcic is inconsistent with the statutory scheme. Mr Marcic's claim is expressed in various ways but in practical terms it always comes down to this: Thames Water ought to build more sewers. This is the only way Thames Water can prevent sewer flooding of Mr Marcic's property. This is the only way because it is not suggested that Thames Water failed to operate its existing sewage system properly by not cleaning or maintaining it.*
>
> *35. On the contrary, it is abundantly clear that one important purpose of the enforcement scheme in the 1991 Act is that individual householders should not be able to launch proceedings in respect of failure to build sufficient sewers. When flooding occurs the first enforcement step under the statute is that the Director, as the regulator of the industry, will consider whether to make an enforcement order. He will look at the position of an individual householder but in the context of the wider considerations spelled out in the statute.*"

722. Lord Hoffmann at [63] , [65],[66] and [70] said as follows:

> "*63.Nevertheless, whatever the difficulties, the court in such cases is performing its usual function of deciding what is reasonable as between the two parties to the action. But the exercise becomes very different when one is dealing with the capital expenditure of a statutory undertaking providing public utilities on a large scale. The matter is no longer confined to the parties to the action. If one customer is given a certain level of services, everyone in the same circumstances should receive the same level of services. So the effect of a decision about what it would be reasonable to expect a sewerage undertaker to do for the plaintiff is extrapolated across the country. This in turn raises questions of public interest.*

Capital expenditure on new sewers has to be financed; interest must be paid on borrowings and privatised undertakers must earn a reasonable return. This expenditure can be met only be charges paid by consumers. Is it in the public interest that they should have to pay more? And does expenditure on the particular improvements with which the plaintiff is concerned represent the best order of priorities?

...

65. The enforcement procedure under the 1991 Act is much more elaborate. The Director has a duty under section 30(4) to consider a complaint and take such steps as he considers appropriate. He has a prima facie duty under section 18(1) to make an enforcement order if he is satisfied that the company is contravening its statutory duty. But that duty is qualified by section 19(1), which provides that he is not required to make an order if satisfied, among other things, that the company is willing to give suitable undertakings or that the duties imposed upon him by Part I of the Act preclude the making of such an order. His duties under Part I require him to exercise his powers in the manner best calculated to achieve certain objectives. The overriding objectives (section 2(2)) are to secure that the functions of a sewerage undertaker are properly carried out and that the undertakers are able "(in particular, by securing reasonable returns on their capital)" to finance the proper carrying out of their functions. More particular objectives are to protect the interests of customers liable to pay charges and promote economy and efficiency on the part of the company.

66. Pursuant to these duties, the Director has addressed himself to the question of flooding and formulated policies which the statutory undertakers should follow. Undertakers are required to submit a quinquennial strategic business plan which includes a statement of the capital expenditure required to achieve a reasonable level of alleviation of flooding. If the Director accepts such expenditure as reasonable, it is taken into account in assessing the charges which will give the undertaker a reasonable return on capital. Otherwise it is not. During the three quinquennia starting in 1990, the Director was willing to allow expenditure on work in relation to properties classified as at risk of internal flooding. But no allowance was made for properties, like that of Mr Marcic, which were only at risk of external flooding.

...

70. My Lords, I think that this remark, together with the judge's frank admission that the fairness of the priorities adopted by Thames Water was not justiciable, provides the most powerful argument for rejecting the existence of a common law duty to build new sewers. The 1991 Act makes it even clearer than the earlier legislation that Parliament did not intend the fairness of priorities to be decided by a judge. It intended the decision to rest with the Director, subject only to judicial review. It would subvert the scheme of the 1991 Act if the courts were to impose upon the sewerage undertakers, on a case by case basis, a system of priorities which is different from that which the Director considers appropriate."

723. Lord Hope of Craighead at [77] and [79] referred to the fact that Parliament had decided that the most appropriate method of achieving a fair balance between the competing interests of the individuals and the community was by means of a statutory scheme administered by an independent expert regulator and also referred to the mechanism which was laid down in the 1990 Act to secure compliance of undertakers with their statutory duties. Lord Hope agreed with Lord Nicholls; Lord Steyn and Lord Scott of Foscote agreed with the opinions of Lord Nicholls and Lord Hoffmann.

724. Because that case concentrated on the building of new sewers for which application was made for expenditure for the relevant AMP, the decision of the House of Lords proceeded on the basis that this was the means of funding; accordingly they stated that the cost of building sewers had to be met out of money received from customers by way of sewage charges and those were subject to limits set by Ofwat: see Lord Nicholls at [24] and Lord Hoffmann at [63] and [66].

Evidence of the funding process

725. In this case one of the issues which arose was the extent to which Thames Water were able to incur expenditure for any works that might be needed to deal with complaints in relation to odour. This question was raised at a Case Management Conference and I ordered that Thames Water were to provide written confirmation of its position on availability of funding mechanisms apart from additional funding from customer bills.

726. In response to that order Thames Water's solicitors wrote a letter dated 8 August 2008 in which they stated: "*...we confirm that in the event that the Court determines that our client failed to take steps which it owed the Claimants a duty to take, our client admits that funding would have been available to it to take such steps whether or not our client was able to raise the necessary funding through customers' bills.*"

727. The question of funding was dealt with by a number of witnesses on behalf of Thames Water and also by Mr Day who was called by Ofwat. Mr Cranshaw dealt with the history of odour control at Mogden and in the water industry generally. He set out the various ways in which Thames Water had carried out work and invested sums to reduce odour at Mogden. Thames Water also called Dr Spillett, Mr Crathorne and Mrs Newman to deal with allegations that Thames Water did not make or attempt to make an exceptionally strong case for enhancements for odour control at Mogden in submissions to Ofwat for AMP2 and AMP3.

728. Mr Day gave evidence in relation to Ofwat's price review process, in general and Ofwat's approach to funding requests for capital projects at Sewage Treatment Works aimed at odour abatement, in particular. He explained Ofwat's role in reviewing water and sewerage undertakers' investment plans and setting annual price limits for each undertaker. He explained that annual price limits are set every five years as a result of undertakers' detailed investment plans known as Asset Management Plans ("AMPs"). He said that the price limits for the AMP2 period (1995-2000) were set by Ofwat in 1994; those for AMP3 period (2000-2005) were set in 1999 and those for AMP4 (2005-2010) were set in December 2004. He said that, in setting price limits, Ofwat made assumptions

about the investment that water companies would need to make but it was for the companies to prioritise and plan the carrying out of actual works to ensure that they met their statutory obligations. He emphasised that Ofwat's assumptions in calculating price limits were without prejudice to the need for companies to meet any of their statutory obligations or to carry out any activity arising from their statutory obligations. He said that companies therefore had to meet their statutory obligations whether this, in practice, cost more or less than the expenditure assumptions made by Ofwat is setting price limits.

729. He explained that water companies or Ofwat can seek revised price limits if certain specified changes occurred in the period since price limits were last set which had a total net value amounting to at least 10% of a company's turnover, which is referred to as the materiality threshold. He explained that these referred to notified items and certain relevant changes of circumstances but stated that Ofwat had not set notified items for the issue of odour control at any price review and Thames Water had not sought an initial determination of price limits to revise the price limits during AMP2 or AMP3. With the exception possibly of an interim determination by Northumbrian Water in 1998 he was not aware of any applications for changes by other companies during those AMP periods which included issues of odour control.

730. He explained that it was during AMP4 that Ofwat provided, for the first time, specific guidance concerning proposals for dealing with odour emissions from existing sewage treatment works. He said that this was largely driven by increased prominence given to the issue of odour nuisance at sewage treatment works with consultations by DEFRA on a draft code of practice in 2002. He said that prior to 2005 Ofwat had not provided explicit guidance regarding the issue of odour.

731. In relation to the AMP2 period he said that Ofwat had assumed that the historic expenditure by water companies on maintaining their assets would generally be adequate for them to maintain the status quo in terms of service to customers and environmental requirements. He said that undertakers were free to make a case that in their particular circumstances the historic levels of expenditure would be inadequate for the future. He said that in setting price limits Ofwat made assumptions about the expenditure necessary which would include, by implication, environmental and other legal obligations including addressing any nuisance from odour at sewage works.

732. He pointed out that Ofwat stated that it expected general improvement in levels of service to be achieved through more efficient targeting of expenditure, changes in operational procedures or efficiency savings at no extra cost to consumers. He referred to Ofwat's framework document, Future Charges for Water and Sewerage Services-the Outcome of the Periodic Review, produced as part of the review preceding the AMP2 period. That set out the following relevant paragraphs:

> "*In the water industry, the Director considers that future improvements in levels of service should be achieved without higher price limits, as in other utilities.*
> …

> *For most water companies, progress towards achieving the improvements proposed in [business plans] should be possible without any special provision being made in the price limit. However, some water companies and most sewerage companies have produced in their [business plans] a scale of enhancement to levels of service over and above those than can be achieved solely through the measures outlined above.*
>
> *In Setting Price Limits for Water and Sewerage Services, the Director explained that he would expect customers to finance such additional enhancements through increased prices only where the company has made an exceptionally strong case…*
>
> *For many companies the Director concluded that there is neither a pressing need for the scale of improvement in service levels proposed nor sufficient evidence of collective customer support to justify any allowance in price limits. In a number of cases, affordability has been critical issue because of the high level of existing bills.*"

733. He said that Ofwat included various assumptions for the AMP2 period but, as a general matter, no such new obligations were agreed for odour from sewage treatment works. He said that, at the time, increased odour abatement so as to reduce odour levels from existing levels was not as prominent an issue as, for example, drinking water quality and waste water treatment and disposal in coastal waters.

734. In the AMP3 period he said that Ofwat's general approach did not change from its 1999 review of price limits for the AMP2 period. He said it made no assumptions in respect of explicit additional expenditure for base service in respect of odour control and there were no new odour reduction obligations required by Government. He said that implicitly companies were expected to manage and maintain their sewage treatment works in such a way as to avoid odour and nuisance. He said that was reflected in Ofwat's framework document, Future Water and Sewerage Charges 2000-05, for the AMP3 period. He referred to section 8 which dealt with improvements to drinking water quality and the water environment and with improvements to address sewer flooding and low pressure. In relation to other improvements, it said as follows:

> "*The Director does not consider that prices need to be increased to allow for other improvements to customer service proposed by the companies. Much has been achieved by the companies over the last five years without any specific allowance in prices and a number of companies have committed themselves to making further service improvements from efficiency savings. The Director believes that the right approach is to provide strong incentives for cost-effective improvement in the areas most valued by customers.*"

735. He said, however, that as the AMP3 period progressed, Government Ministers became concerned about apparent rising levels of pubic complaint about odour from sewage

works and signalled their intention to tackle the issue. He referred to the consultation by DETR on proposals for the statutory control of odour and other nuisance from sewage treatment works which were produced in December 2003. He also referred to the impact of the High Court decision in London Borough of Hounslow v Thames Water Utilities Limited [2003] EWHC 1187 (Admin) in May 2003 which decided that the statutory nuisance regime applied to odour from sewage treatment works. He said that DETR subsequently progressed development of a voluntary code of practice on odour nuisance from sewage treatment works which was ultimately published in April 2006. He says that the development of the code of practice was already well under way during the review of prices for the AMP4 period.

736. He said that, as part of the price setting process for the AMP4 period, Ofwat therefore issued specific guidance to companies at Annex 2 to the MD190 letter which supplied further guidance to companies on the contents of their final business plans. That annex provided as follows:

> "*Later this year Ofwat expects there to be a non-statutory code of practice for managing odour at sewage treatment works. We will expect each sewerage company to develop its policy and strategy for odour management to reflect the practices, processes and technologies recommended in this code. Plans to meet and maintain compliance with the code will form part of the output expectations for each company for AMP4.*
>
> *We require each company to demonstrate why and how its policy for odour management has or will change from AMP3, the consequences of changes in policy and how the company has developed, appraised and adopted the strategy upon which its AMP4 and onward investment proposals are based. To date we have considered management of odour to be an integral element of a company's functions and carried out as a matter of course consistent with its established policy. Companies' established policies should provide for maintaining good operational practice to minimise odour risk (good housekeeping) and the provision, operations and maintenance of routine odour control measures. Odour control measures should take site-specific circumstances into account, both odour generation, control and impact on the surrounding environment.*
>
> *We recognise that companies may be under increasing public pressure to mitigate the impact of odour, and that the forthcoming code may, in some circumstances, require some companies to implement measures that go beyond their established policies and practices…*"

737. The annex also provided detailed requirements of what had to be included in the business plans. Mr Day said that, following the announcement of Ofwat's new approach, ten companies came forward with proposals for capital investment to abate nuisance from odour from sewage treatment works. In total the companies estimated that they needed to spend an additional £290 million on new odour reduction equipment. He says that taking account of ministerial guidance, the emerging principles under consideration for the

DEFRA code of practice and the justification offered by companies in specific locations, Ofwat included expenditure assumptions in price limits for specific additional or new odour abatement schemes. He said that the final determinations assumed £131 million in capital investment with additional operating costs of about £7 million a year across the industry.

738. Finally he dealt with Thames Water's investment proposals in the AMP2, AMP3 and AMP4 periods. He said that, in addition to expenditure of nearly £4million already allocated for the period, Thames Water identified proposals for approximately £8.5 million additional expenditure for additional odour schemes to resolve further problems as they became a source of complaint but that Thames Water made no specific reference to Mogden STW. He said that Ofwat considered these proposals but concluded that there was insufficient need or collective customer support for sewage works odour reduction to justify the additional charges to customers to finance these enhancements. He said that this conclusion was consistent with Ofwat's overall policy approach to limit expenditure assumptions relating to service enhancements.

739. He said that in Thames Water's proposals for investment in the AMP3 period they had stated that they had carried out a number of outputs in AMP2 that were in addition to the regulatory outputs required for that period. They stated that these additional outputs included odour management and control measures at nine unspecified sewage treatment works. He said that Thames Water proposed odour control measures at five sewage treatment works, not including Mogden STW, to alleviate odour problems related to recent developments encroaching their sites. This proposal was awaiting confirmation from the Government that there was such an obligation but he said that no such confirmation was subsequently received. Thames Water also proposed works to reduce odour at five works per year as enhanced service measures at a cost of £9.9 million and he said that Mogden STW was identified for work at the start of the AMP3 period in 2000 to 2001. In the draft strategic business plan dated April 1999 at Section D7.2 Service Enhancements - Sewerage it stated as follows:

> "*It is proposed to deal with odour at sewage works at a greater rate than currently, by implementing technical solutions to resolve process stream problems at an additional five sites per year.*
> *The Thames Water Odour Working Group have scoped and costed each site identified and prioritised as having odour management needs. As many of the technical solutions to be implemented such as washpacters, chemical scrubbers and ammajets, are relatively new for Thames Water, we do not have sufficient data to generate cost models. Our approach has therefore been to use the AMP3 cost model methodology with the best available data.*
> *The Estimated capital costs is £9.9 m over the 5 year period and is over and above the current levels of expenditure in AMP2 of £7-8 m on odour control which has been included in Capital Maintenance. The annual operating cost of £0.1m relates to additional costs for chemicals and power. The impact on the average bill is estimated as 20p.*"

740. Mr Day said that Ofwat did not include an allowance for theses service level improvements and stated the reason as follows :

> "*The proposal to deal with odour from sewage treatment works has been dealt with consistently with proposals included within the company's quality programme. Ofwat has not included and allowance for these improvements as such problems should be resolved through normal business operations.*"

741. In his evidence Dr Spillett said that in the AMP2 and AMP3 periods Thames Water did all that they could to obtain additional funding to combat odour, including proposals in relation to Mogden STW. He said that this included canvassing customer support to tackle odour and presenting the results of customer research to Ofwat. However he said that Thames Water's proposal was rejected out of hand by Ofwat on each occasion. He said that Ofwat's focus was, instead, very much on funding the enormous costs of the water companies' compliance with the mandatory environmental and water quality standards enacted by the EU. He said that Ofwat clearly did not view odour as a priority but simply said that the water companies should carry out odour control measures as part of their routine maintenance of sewage treatment works. Despite those rejections, he stated that Thames Water spent some additional sums over and above the very small sums available in the "Base-Capital Maintenance" budget in attempting to tackle the odour situation at Mogden STW as part of Thames Water's maintenance of that site. He said that such sums were not approved by Ofwat and were therefore funded by Thames Water out of their own pocket.

742. He said that in the run up to the AMP4 period Ofwat's attitude towards odour began gradually to change, not least because of work on DEFRA's draft code of practice regarding odour nuisance at sewage treatment works and because odour had attained a greater public and political prominence. He said that, however, even at this stage Ofwat was very reluctant to allow Thames Water anything near the full amounts of funding they were seeking and eventually granted Thames Water approximately 30% less than the amount they had applied for to cover part of the works at Mogden STW. He said he did not therefore believe that there was any prospect of Ofwat granting Thames Water any additional funding for odour prior to the AMP4 period.

743. In his Witness Statement Dr Spillett goes on to explain that Thames Water did spend some additional sums "out of its own pocket" on seeking to improve the odour situation at Modgen STW prior to the AMP4 period despite Ofwat's refusal to grant additional funding, but that Thames Water could not readily fund significant capital works without Ofwat's prior approval.

744. He explained the approach of Thames Water in respect to the AMP 1 period and referred to the long term investment plan and corporate plan in 1998 in which Thames Water referred to a policy of keeping odour nuisance to a minimum and ensuring that no significant smells were discernable by local residents beyond a radius of 800 metres from the works boundary. He also referred to expenditure of £2.9 million over the five year period in dealing with odour emanating from Thames Water's sewage treatment across

all of over 400 sewage treatment works. In relation to the AMP 2 period Dr Spillett was responsible for the preparation of Thames Water's submission for funding. He referred to a paper prepared by the Water Services Association ("WSA") for Ofwat and to an independent assessment carried out by WS Atkins in December 1992, which was also sent to Ofwat. He said that these illustrated that various water companies were attempting to consolidate and develop their thinking about what work was required to combat odour and how much it might cost.

745. He said that, shortly after privatisation, Ofwat set up a sub-group to examine customer levels of service (known as DG levels of service) in the AMP1 period and the run up to the AMP2 period. He said that Thames Water were keen to persuade Ofwat to elevate odour to a DG level of service because this would mean that odour control would be based on and regulated under a specific set of standards. He said he presented to that sub-group evidence of the odour complaints that Thames Water had received to support their argument that odour was a legitimate customer concern that should be elevated to a DG level of service. In response Ofwat's customer service manager, Mr Mike Saunders, adduced evidence of a greater level of customer complaints in relation to, amongst other things, sewer flooding and low pressure water and said that such areas should be priorities and that there was not sufficient evidence to justify elevating odour to a DG level of service.

746. He also referred to the Ofwat paper issued in November 1993, "*Setting Price Limits for Water and Sewage Services. The Frame Work and Approach to the 1994 Periodic Review*" and said that the paper made it clear that Ofwat would be seeking to curtail any price increases so far as possible in the AMP2 period and the funding obtained through customer charges would be prioritised towards meeting mandatory obligations such as those imposed by the UWWTD. He said that where customers wanted improvements in the levels of service such as odour control over and above the small allowance in the charges, funding would only be available if there was very clear evidence of customer support for that. Dr Spillett referred to meetings in November and December 1993 which showed that Ofwat was to issue its draft determinations in mid-May 1994 and final determinations in July 1994 in relation to the AMP2 period.

747. He also referred to an internal Thames Water document in relation to enhanced levels of service and referred to putting forward a case for funding for, amongst other things, odour control. In a detailed briefing note, Thames Water said their main objective was to convince Ofwat of a special case regarding London sewage problems, covering sewer flooding, storm overflows and sewer refurbishment. There were then supplementary objectives and it also stated "*In addition justification is made for other areas which Ofwat may regard as discretionary, such as…odour*". As a result of that document Dr Spillett said that he attended a meeting between Thames Water and Ofwat in January 1994 when the above arguments on enhanced service levels, discretionary spending and odour were raised. He said he did not recall the precise details of the discussion but he did recall that Thames Water pressed Ofwat hard to agree to additional funding for various enhanced services including enhanced odour control. He said that Thames

Water's application for additional funding for odour, for AMP2 period, was subsequently rejected.

748. Dr Spillett said that he played a significant role in the preparation and drafting of Thames Water's Strategic Business Plan in March 1994. He referred to the statement that the level of additional funding that Thames Water were seeking for "Sewage odour control" under DG levels of service was 0.2% of the total funding that Thames Water were seeking. He said that in the Corporate Business Strategy appended to the Strategic Business Plan, Thames Water had included a detailed section on sewage odour control. Under the heading "costings and time scales" they had referred, in relation to odour, to a number of problem sites which had been studied in detail and stated that the AMP 2 odour control project had identified the need for a relatively small investment provision of £8.458 million in addition to the investment already allocated to odour control in the capital programme of £3.953 million. He said that although Mogden STW was not mentioned by name as one of the problem sites studied in detail, he recalled that Mogden STW was one of those sites.

749. He referred to a report produced by WS Atkins which stated that Thames Water would continue with their policy of reacting to odour complaints but, in addition, would carry out periodic surveys aimed at putting odour control measures in place before odour control problems attracted complaints.

750. Dr Spillett pointed out that in the Ofwat draft determination received in May 1994, whilst Thames Water had asked for a "K value" of 4.1%, Ofwat had said it would only allow a "K value" of 0% for the next 10 years. Ofwat said that it expected the water industry to achieve an average cost reduction of 4% in its capital expenditure programme, together with a continuing annual reduction of 1% a year. Dr Spillett said that Thames Water then met Ofwat in June 1994 and prepared a briefing paper which included, in relation to several service levels, the comment:

"*We note, with disappointment, that you have chosen not to allow any expenditure for other service areas such as supply interruptions, resource deficiencies, odour control. We do not believe that the package you propose in the Draft Determination will allow us the scope to achieve these improvements for our customers from additional efficiency savings.*"

751. At the meeting Dr Spillett said that Thames Water reiterated their disappointment that no funding had been allowed for odour and said that they had provided sufficient evidence of customer support for enhanced expenditure on odour. They therefore asked Ofwat to reconsider its position. He said that in Ofwat's Final Determination there was no provision for odour and that future improvements in levels of service were to be achieved without higher prices through efficiency savings.

752. He concluded that, in the AMP 2 period, Thames Water were not allowed any additional funding over the very small amounts already in the base to combat odour, despite the fact that Thames Water had pressed Ofwat very hard to grant additional sums for this.

753. In the AMP 3 period, although Dr Spillett was not personally responsible for Thames's preparatory work for AMP3, he was still heavily involved because of his previous experience. He prepared a document for Ofwat with the title "Main Quality Costings Submissions-May 1998" which referred to odour control so that previous expenditure could be "logged up" as part of the funding arrangements. There was reference to the fact that odour complaints might result in Abatement Notices and an estimate that about 26 sites would need attention with a current forecast cost of some £10 million. Dr Spillett said that this showed that Thames Water were pressing Ofwat to allow funding for odour. He referred to other documents prepared in 1998 which were sent to Ofwat indicating the need for funding for odour management and control work. He said that in a document in October 1998 Ofwat indicated the areas of enhanced service which did not include odour and that it appeared that only Thames Water and Anglian Water were pressing for extra funding to combat odour.

754. He also said that he was author of a document produced in December 1998 which referred to controlling odour issues at five sites at a cost of £1 million between 2000 and 2005. he said that so far as he was aware Mogden STW was not one of the five sites referred to because the housing encroachment around Mogden STW had taken place many years previously and was not a "new issue".

755. Mr Spillett referred to the Strategic Business Plan prepared for the AMP3 period. In that document Thames Water stated that they had undertaken a considerable supplementary investment programme to deliver various outputs for which Ofwat had not provided funding during AMP 2 period and the document also recorded that money had been spent on odour management and control at nine sewage treatment works. Dr Spillett said that he believed that Mogden STW was one of those works although he did not know how much was spent there.

756. He referred to a paragraph in Part B of the Strategic Business Plan where Thames Water reiterated that they had identified works on odour control as an area for investment in AMP 3 and that major capital maintenance work was due to be carried out at Mogden STW . He then made reference to the other parts of the Strategic Business Plan which were dealt with by Mr Day.

757. He said that WS Atkins carried out an independent audit of the Strategic Business Plan and commented:

"*Thames has assessed and costed in some detail, specific works at each site to reduce odour. This approach is appropriate and, in our opinion, the enhanced service level expenditure proposed for odour control is a reasonable estimate for the new assets needed to reduce odour from the 25 treatment sites identified.*"

758. He emphasised that WS Atkins, as independent reporters, owed a duty to Ofwat and pointed out that they considered that Thames Water's estimate of costs for tackling odour was reasonable. He said that Ofwat issued its Final Determination and, in a Supplemental

Report which specifically dealt with Thames Water, Ofwat did not mention Thames Water's application for funding to tackle odour at sites with recent housing encroachment. In relation to the application for around £10 million to tackle odour as a service enhancement at 25 sewage treatment works, including Mogden STW, Ofwat did not consider that prices needed to be increased to do this.

759. Notwithstanding Ofwat's refusal to grant funding in the AMP 3 period, Dr Spillett said that Thames Water spent further unapproved sums of £5m in that period on seeking to address the odour complaints at Mogden STW. He referred to a letter from Mr John Sexton, Thames Water's former Managing Director, to Mr Philip Fletcher, Ofwat's Director General of 5 March 2003. That letter said as follows:

> "*The AMP3 determination contained no specific allowance for odour problems at any site, the Ofwat view being that "improvements to deal with odour should be resolved through normal business operations". Whilst this may be a reasonable view for new/replacement plant, this is difficult to reconcile with retrofitting abatement equipment to existing plant… Notwithstanding the AMP3 determination, we are spending in excess of £5m in this period to manage the odour problem at Mogden… An incremental approach to improvements is being taken…The ultimate aim of [the Mogden Resident's Action Group] would appear to be the covering of all odorous processes. Not only would this cost several tens of millions of pounds for an old works the size of Mogden, but it raises some significant [health and safety] issues around explosion risk.*"

760. In her evidence Mrs Newman dealt with the availability to Thames Water of other funding mechanisms. She confirmed that capital works and investment which are not approved by Ofwat do not form part of Thames Water's Regulatory Capital Value ("RCV") and that Thames Water do not earn a rate of return on those works or that investment. She said that Thames Water had to satisfy shareholders that the return on their investment was sufficient to warrant maintaining their shares and that this is particularly relevant in Thames Water's case because they had remained broadly cash flow negative since privatisation and had become increasingly financed by debt as opposed to equity. She said that therefore Thames Water cannot readily fund significant capital works "out of its own pocket" without Ofwat's prior approval.

761. She said that it was evident that, whilst Thames Water did have other sources of funding which included borrowing and shareholder funds, the significant funding for Thames Water came from customer charges which are limited by the funding process operated by Ofwat in AMP periods.

Decision

762. The issue of justiciability relates to only a number of the Particulars of Negligence ("PoN") (8 – if capital work, 14, 20, 20A, 20C, 21, 22, 23) reflected by similar items on the Schedule of Failings ("SoF") (1C, 3A, 3D (install automatic emptying), 3E (failing to install automatic washing equipment), 3G, 4A (new scrapers), 4B, 4C, 4E, 7A). It follows that a number of Particulars of Negligence (1(as held in the First Judgment), 3 to 7, 8 – if

not capital work, 9 to 13, 15 to 19, 20B, 24 to 27) and items in the Schedule of Failings (1A, 1B, 2, 3B, 3C, 3D (emptying efficiently), 3E (cleaning efficiently), 3F, 4A (maintenance/operational failures), 4D, 7A, 11, 12, 13 and, if not new plant: 8A, 8B, 9, and 10) are not contended to be non-justiciable by Thames Water.

763. In essence the allegations which are in contention are these:

(1) Failure of the design of the UWWTD Scheme (PoN 20A)
(2) Covering the Inlet Works (SoF 1C)
(3) East side PSTs to FSTs (PoN 20C, SoF 3A)
(4) Automated Storm Tank emptying (PoN 20, SoF 3D)
(5) Automated Storm Tank washing (PoN 20, SoF 3E)
(6) Covering Storm Tanks (PoN 21, SoF 3G)
(7) New scraper systems for PSTs (SoF 4A)
(8) Replacing PFTs with alternative sludge thickening plant (PoN 22, SoF 4B)
(9) Temporary increase in sludge thickening plant (PoN 23, SoF 4C)
(10) Covering PSTs (PoN 21, SoF 4E)
(11) Digester control, fixed roof/bag system (PoN 8, SoF 7A)
(12) Providing new OCU plant (PoN 14, SoF 8A, 8B, 9, 10)

764. Before turning to those items, there are issues of principle which I have to consider. First there is the availability of funding and then there is the question of the powers of enforcement vested in Ofwat under the WIA.

765. It is accepted by Thames Water, as set out in their solicitors' letter of 8 August 2008 that "*in the event that the Court determines that our client failed to take steps which it owed the Claimants a duty to take, our client admits that funding would have been available to it to take such steps whether or not our client was able to raise the necessary funding through customers' bills.*". It is also clear from the evidence of Mrs Newman that there was an element of efficiency saving where funding had been applied for and obtained but had not been spent on particular projects. She confirmed that Thames Water were able to make efficiency savings which meant there were sums available. There are therefore other sources of funding which Thames Water could apply to deal with odour control. In Marcic these other sources of funding were not considered.

766. However, whilst the Marcic decision did not consider all the sources of funding available to Thames Water to deal with odour control I consider that for significant investment in new plant Thames Water could only reasonably be expected to fund that work under the funding mechanism in the relevant AMP period. Any decision by the court that Thames Water should have spent significant sums of money in a particular AMP period on improving odour emissions by way of providing major capital plant or carrying out major capital projects would, in my judgment, be inconsistent with and conflict with the statutory process conducted by Ofwat under the WIA. The question of investment in major plant or projects would, I consider, necessitate the use of money derived from customers' bills and the decisions on what plant and projects a water company can invest in is evidently a matter for determination by Ofwat in any particular period balancing the

needs of the water industry and the particular water company against the amount which should be paid by customers.

767. Obviously what is major plant or a major project and what is minor is a matter of fact and degree. In general minor capital plant or minor capital projects would come under capital maintenance where a water company would have to allocate funds that it has for capital maintenance by balancing the needs of a particular facility with the needs of its overall facilities. Whilst the overall sums available for capital maintenance would depend on funds made available by Ofwat through customer bills, in this case it is Thames Water's decision whether they should spend capital maintenance funds. I do not therefore consider that decisions on items of plant or projects which amount to capital maintenance would therefore generally be within the statutory scheme. It follows that decisions of this court where there has been Allen negligence in relation to minor capital plant or minor capital projects which would generally come within capital maintenance would be justiciable because such decisions would not conflict with or be inconsistent with the statutory scheme.

768. It is clear from Thames Water's statement in the letter of 8 August 2008 that there are funding mechanisms which would be available for Thames Water to discharge their Allen duties. As the Claimants point out in the overall scheme of things there are other sources of funding. That does not seem to me to alter the general principle that certain investment decisions have to be made with the involvement of Ofwat so that the interests of the customer paying bills which provide finance can be balanced with the investment plans of the water companies using that finance. Thus, if a water company has funds available from other sources such as sales of land, capital efficiency or sums that would otherwise be distributed to dividends, that should not avoid the need to involve Ofwat in major investment decisions.

769. In relation to enforcement, I accept that in Marcic Lord Nicholls, in particular, put forward the enforcement regime as an important aspect in distinguishing between matters which could be dealt with by the courts and matters which were within the statutory scheme administered by Ofwat. In my judgment that was not intending to say that every claim which could, in principle, be brought within the statutory enforcement scheme had to be brought within that scheme and could not be brought in the courts. Rather, I consider that he was emphasising the enforcement element of the statutory scheme as being an additional reason why the courts should not be involved in the determination of investment decisions for major works or major projects which are matters for Ofwat.

770. I now deal with the justiciability of the particular claims:

771. Failure of the design of the UWWTD Scheme: The UWWTD Scheme formed part of the investment which was approved by Ofwat in the AMP2 Period. There is therefore no question as to the funding of the work. If in designing that scheme Thames Water breach their Allen duty and this causes an odour nuisance then I see no reason why there would be any conflict with the statutory scheme which would make this claim non-justiciable. In Marcic, for instance, if the sewer flooding had been caused by defectively designed

sewers funded through the Ofwat mechanism, I see no reason why Mr Marcic should not have recovered.

772. In this case Thames Water, through the Ofwat funding mechanism, were provided with sufficient funds to carry out the UWWTD scheme properly. If they have been negligent in the design then they have to pay for the remedial work, subject to any recovery from a third party. In this case the evidence would show that they made a substantial cost saving by designing the UWWTD Scheme in the way they did. That would be one source of funding to remedy defects but, more generally, as accepted in the letter of 8 August 2008 Thames Water accept that they would have funding available. The claim based on the failure of the design of the UWWTD Scheme would therefore be justiciable.

773. Covering the Inlet Works, Storm Tanks and PSTs: Projects to carry out these major works are, in my view, clearly within the scope of the Ofwat funding mechanism and I consider that a decision by this court on the question whether Thames Water should have covered these parts of Mogden STW would be inconsistent with and in conflict with the statutory scheme. The claims that Thames Water should have covered the Inlet Works, Storm Tanks and PST are therefore non-justiciable.

774. East side PSTs to FSTs: The conversion of the East side PSTs into FSTs is a major scheme which involved a change in the process from two stage primary settlement to one stage primary settlement with larger final settlement capacity. Such a project would, I consider, be a matter for Ofwat approved funding under the statutory scheme in the same way as covering parts of the process. The claim that Thames Water should have converted the East side PSTs into FSTs is therefore non-justiciable.

775. Automated Storm Tank emptying, Automated Storm Tank washing, New scraper systems for PSTs: These relate to the upgrading or replacement of comparatively minor parts of Mogden STW because the performance of the existing system was less effective than it should have been. Whilst I accept, on the evidence, that the cost of carrying out this work is significant, I consider that these are the type of element which would be dealt with as operational matters, effectively as capital maintenance of the existing plant. I would not therefore expect these to be the subject of a particular investment decision by Ofwat under the statutory scheme. Rather, in my judgment, it is for Thames Water to decide how and when they carry these works out. It is for Thames Water to decide whether and how to include this work and, if so, in what stages, as part of the discharge of their Allen duty. I therefore consider that the claims that Thames Water should have automated the Storm Tank emptying process to make it more effective, should have introduced an automated Storm Tank washing system to overcome the inefficient cleaning system and should have replaced the scraper systems on the PSTs with more effective systems are all justiciable claims.

776. Replacing PFTs with alternative sludge thickening plant and introducing temporary sludge thickening plant: The change in thickening process from PFTs was clearly a major change in process. I consider that the decision to replace the PFTs with an alternative means of sludge thickening would involve a major project and major works which would

properly fall within the Ofwat funding mechanism under the statutory scheme. I consider that the claim that Thames Water should have replaced the PFTs with alternative sludge thickening plant is therefore non-justiciable.

777. The introduction of temporary plant to overcome a particular operational problem or to test the effectiveness of a sludge thickening process would, I consider, generally be an operational matter which Thames Water would be expected to carry out as part of small works included within, for instance, capital maintenance. It follows that the claim that Thames Water should have introduced temporary sludge thickening plant to overcome process problems is, in my judgment justiciable.

778. Digester control, fixed roof/bag system: The need to introduce a control system for the bell height on the digesters to avoid gas escaping from the digesters is a matter of adapting or remedying a relatively minor aspects of the existing plant. I would expect this to be part of small works included within, for instance, capital maintenance. It follows that the claim that Thames Water should have introduced a digester control system to overcome process problems is, in my judgment justiciable.

779. The change of the floating roof digester system to one using fixed roofs and gas bags is a much more major project requiring major works. These are the type of works which, in my judgment, would properly fall within the Ofwat funding mechanism under the statutory scheme. I consider that the claim that Thames Water should have converted the digesters to a fixed roof/gas bag system is therefore non-justiciable.

780. Providing new OCU plant: This item depends on the scope of and reason for the new plant. If there was alleged to be a need for a major scheme to replace a substantial number of OCUs with a new odour abatement system or to introduce OCUs into a process which did not have them before then I consider that this could fall within the Ofwat funding mechanism under the statutory scheme and therefore be non-justiciable. If however, this is a claim that Thames Water should replace an OCU which is performing badly, for whatever reason, with another OCU so as to achieve the required abatement then I would expect this to be part of small works included within, for instance, capital maintenance and the claim would, in my judgment, be justiciable.

781. In respect of my findings in relation to the Schedule of Failings and Particulars of Negligence, it follows that I have not, in the event, found that Thames Water are liable in respect of any matters which I have held above to be non-justiciable.

782. I now deal with the relevant Particulars of Financial Negligence.

Financial Negligence

Particular of Negligence 1: Although aware of the need for works to deal with odour at MSTW, Thames Water failed and neglected to press for capital funding for odour related expenditure within the AMP system prior to 2004

The Claimant's submissions

783. As set out in the first judgment at [170] and [172], I have already determined that this allegation is justiciable but that determination was without prejudice to any contention by Thames Water that it did not owe any duty to press for such funding, or whether Thames Water was negligent in not doing so.

784. The Claimants submit that an exceptional case could and should have been made by Thames Water for odour control works at Mogden STW for the AMP 2 and AMP 3 periods. They say that Thames Water did not make such a case or attempt to do so. They only made a general case for odour funding at a number of works.

785. In relation to the two AMP periods, the Claimants refer to the evidence of Dr Spillett as follows:

(1) In relation to the AMP2 period, they refer to his evidence that Ofwat did not allow Thames Water any additional funding despite the fact that Thames Water had pressed Ofwat very hard to grant additional sums for odour control. They say he accepted that the funding submissions made in the AMP2 period for odour reduction were uncertain and they submit, although Dr Spillett did not accept this, that the AMP 2 submissions appeared to have been based simply on odour complaints received.

(2) In the AMP3 period, they refer to Dr Spillett's evidence that overall Thames Water put forward a very strong and compelling case in the Strategic Business Plan to obtain additional funding to combat odour, including funding for work at Mogden STW which would have commenced in 2000. The Claimants say that this funding was relatively minor as Thames Water were looking at reasonable odour control through maintenance and good practice and the funding to combat odour was part of a general proposal and not a specific proposal for Mogden STW. They say that where funding was sought for odour control at five sites, Mogden STW was not one of them.

786. They refer to Mr Day's evidence that companies must meet all legal obligations and submit that if a nuisance was being caused to residents then an exceptional case should have been made in order to meet Thames Water's obligations in respect of their liability under Allen. They say it was for Thames Water to make their responsibility to deal with any nuisance clear to Ofwat, if necessary explaining the legal position. They rely on Mr Peirson's evidence on the need for a properly based case for funding which should include an objective odour impact assessment. They submit that Thames Water never made or attempted to make such a case.

787. The Claimants also refer to Mr Hibberd's evidence where he sets out maters in respect of which Themes Water could have applied to Ofwat for funds which would have improved process management, such as replacing the PFTs, which would have had side benefits of odour reduction.

788. The Claimants say that had an exceptional case been made to Ofwat, then as Mr Day said in his evidence on Day 18, Ofwat would have assessed whether Thames Water had made the case that it needed to make specific investment to deal with the odour issue. They refer to Dr Spillett's evidence that he would have expected Ofwat to take very seriously a case that expenditure was needed to ensure that Thames Water were complying with their legal obligations.

789. The Claimants submit that the failure to make an exceptional case was a failure under the Allen definition of negligence because it was a failure to take all reasonable regard and care for the interests of the Claimants.

790. In relation to the contention that Ofwat would not have granted such funding, and therefore that any negligence in failing to make the case was not causative of nuisance, the Claimants submit that since no exceptional case was made the matter becomes one of supposition. The Claimants submit that on the evidence there was a real or substantial chance that Ofwat would have provided funding if Thames Water had made an exceptional case that they needed such funding at Mogden STW to comply with their legal obligation not to cause odour nuisance. They refer to the Court of Appeal decision in Allied Maples Group Ltd v Simmons & Simmons [1995] 1 WLR 1602 at 1614 D and submit there was a reasonable chance of obtaining funding and in such circumstances Thames Water failed to satisfy their duty under Allen.

791. Further the Claimants submit that neither Ofwat nor Thames Water can be heard to say that funds would not have been available to enable Thames Water to comply with their legal responsibilities. They refer to the fact that the House of Lord decision in Marcic was handed down in December 2003 and could not have been relied upon to resist a funding claim by the Defendants or Ofwat prior to that date and, in any event. Thames Water have never suggested that the Marcic immunity applies in response to statutory nuisance proceedings.

Thames Water's submissions

792. Thames Water submit that in the context of a claim in nuisance, where there is damage to a property interest caused by a defendant carrying out its statutory duties, the relevant principles are those set out by Lord Wilberforce in Allen and, in this case, subject to justiciability, Thames Water were under a duty to conduct the operation at Mogden STW with all reasonable regard and care for the interests of other persons. Thames Water submit that there is nothing in Allen to support a common law duty on Thames Water to press Ofwat for capital funding. Thames Water submit that it was not the omission to apply for funding that was, on the Claimants' case, the effective and proximate cause of the damage; it was the lack of performing some physical act at Mogden STW such as installing covers on the storm tanks or repairing a defective OCU that on the Claimants' case caused the nuisance and the damage.

793. In any event, Thames Water say that the decision in Marcic is fatal to any submission by the Claimants' that Thames Water owed an Allen duty to apply for funding for the purpose of carrying out capital works falling on the non-justiciable side of the boundary.

794. Thus, Thames Water's case is that "Financing Particular of Negligence 1" is, on its own, insufficient to constitute Allen "negligence". In order to disclose a sufficient allegation of negligence by omission the claimants must go on to allege and prove that (whether or not Thames Water should have pressed Ofwat for funding by some particular time) Thames Water negligently omitted to carry out and commission specific works at Mogden STW by some particular time. That is the only relevant allegation of negligence by omission. The only omissions capable of preventing a nuisance at Mogden STW were omissions to perform specific acts at Mogden STW.

795. Thames Water submit that these allegations fail on the issue of justiciability because they are capital works and by any definition the magnitude of their impact is such that it potentially cuts across the statutory scheme which it would affect significantly.

796. If, contrary to that submission, Particular of Negligence 1 does disclose a sufficient Allen cause of action on its own, then Thames Water deny that they failed and neglected to press for capital funding for odour related expenditure within the AMP system prior to 2004. They say that they did everything that it reasonably could to persuade Ofwat to authorise capital funding for odour related expenditure during the AMP periods prior to 2004.

797. Thames Water emphasise that Ofwat does not in general "authorise funding" for specific projects, or specific expenditure, Ofwat limits what undertakers can charge customers for their services during the relevant AMP. They refer to what Mr Day said on Day 11, that Ofwat determines, in broad terms, the revenue envelope that a company can recover from its customer base and it is then up to the company to decide how it is going to finance its functions within that envelope.

798. Thames Water refer to the framework and approach set by Ofwat in relation to the 1994 price review (PR94) for AMP2 (1995 to 2000) in the paper entitled "Setting price limits for water and sewerage services" where Ofwat stated in the Foreword to the document that the more expensive the quality and environmental obligations are, the less scope there was for other improvements within an overall price cap which is acceptable to customers. Ofwat said that Undertakers were to fund improvements in standards of service "*through greater efficiency rather than higher prices ... Price increases should be limited to what is necessary to meet new quality and environmental obligations*". There would need to be "*a very strong case for financing discretionary improvements through higher prices.*" Thames Water also rely on the recognition by Ofwat in the same paper to the limitations on undertakers in respect of "capital maintenance". Ofwat said that over the longer term all assets were to be properly maintained, but in the shorter term capital maintenance programmes would "*result in the condition of some assets improving while others deteriorate. Given the pressure on bills, capital maintenance activity in the shorter term should be concentrated wherever possible in areas where there are clear benefits for water and environmental quality standards*".

799. Thames Water say that, as explained by Dr Spillett at paragraphs 22.3, 22.5 and 28 of his witness statement, capital maintenance counts as "capital" for purposes of funding, as it adds to the RCV of Thames Water's assets upon which they are allowed a reasonable rate of return and is to be distinguished from day-to-day maintenance of assets and consumables, which fall within operational expenditure or opex. Thames also say that capital or capital maintenance spending which goes beyond the parameters which Ofwat allows do not count towards the RCV and hence Thames Water's rate of return, unless Ofwat expressly approves it. Equally, Thames Water say that, as Ofwat states in its November 1993 framework document "*profits should be sufficient to attract and retain capital in the business*."

800. Thames Water say that they did press Ofwat hard for funding for odour related expenditure for AMP2 (1995 to 2000) and was one of the few water companies keen to persuade Ofwat to elevate odour to a "DG" level of service. They say that as Dr Spillett emphasised in answer to questions from Mr Hockman on Day 10 "*odour was sufficiently important and a problem, to have this DG levels of service status*" and so made a case to Ofwat based on the number of complaints but Ofwat's response was that odour in itself was not worthy of DG level recognition or elevation. Rather Ofwat did not authorise funding over and above the "base" level on the ground that there was "*insufficient need or collective customer support*" for odour reduction at sewage treatment works to justify additional charges to customers to finance these enhancements. In coming to this view, Thames Water say that Ofwat was making its own assessment of the then current strength of feeling about odour from sewage treatment works. Thames Water say that in exercising its discretion by not authorising funding for new quality and environmental obligations, Ofwat determined the line which it would take when considering the adequacy or otherwise of an undertaker's performance of its statutory duty under s.94(1)(b) at that particular time.

801. Thames Water submit that the effect of Ofwat's determination was that, first, the prices payable by customers for water and sewerage charges during the AMP2 period (1995 to 2000) should not reflect the cost to Thames Water of preventing any de facto nuisance caused by the omission to construct new capital works to meet new quality and environmental obligations; secondly, that it was not "negligent" of Thames Water not to construct such works during AMP2 (1995 to 2000), and accordingly, thirdly, that no enforcement proceedings should be taken against Thames Water in respect of any such omission.

802. Thames Water also say that in 1998-1999 (PR99) leading up to the AMP3 period, they again pressed hard for funding on odour related matters and they rely on Dr Spillett's evidence. In response, Thames Water say that Ofwat took a similar stance in respect of the AMP3 as the AMP2 period.

803. In any event, if the court were to determine, contrary to those submissions, that Thames Water were in breach of an Allen duty in applying to Ofwat for funding, they say that the issue of causation arises as to whether or not Ofwat would or might have granted more money in either AMP2 or AMP3? Even if Ofwat would or might have granted more

money the question is whether it would have enabled Thames Water to cover the storm tanks and/or inlet works, and would Thames Water subsequently have covered the storm tanks and/or inlet works, and if so by what date? Thames Water submit that this raises the issue of the basis on which the court should assess the position, in particular, the application of the loss of a chance approach applied by the Court of Appeal in Allied Maples Group Ltd v Simmons & Simmons [1995] 1 W.L.R. 563 and subsequently in a number of cases including the decision of Vos J in Dennard v. Pricewaterhouse Coopers LLP [2010] EWHC 812 (Ch) where the question of the outcome of a breach depends on the action of a third party.

804. As the courts have stated in Allied Maples and subsequent cases, the loss of a chance approach consists of two stages, first that a claimant must show that there was a real or substantial chance, as opposed to a speculative one, that the third party would have acted in a particular way. Secondly, if that is established then in assessing quantum the court assesses the percentage chance that the third party would have acted in such a way which it then applies to quantum assess on the basis that the third party would have acted in that way. Thames Water points out that there are substantial difficulties of analysis in applying the Allied Maples principles to the present case because the Claimants are not claiming damages for loss of a financial benefit from the third party but the loss is to Thames Water.

805. In any event, Thames Water say that by far the most likely outcome is that Ofwat would have rejected any more ambitious application in respect of AMP 2 and AMP 3, as it did in response to the applications made. Even if Ofwat had allowed some modest increment to the sum allowed, the Claimants cannot show that this would have led to any material improvement in offsite odour. Overall therefore the most probable outcome is no improvement in odour.

Decision

806. The first question is whether this claim arises under Allen negligence at all. The principle which I derive from Allen as applicable to this case, as set out above, is that Thames Water had to carry out the work and conduct the operation at Mogden STW with all reasonable regard and care for the interests of other persons, including the Claimants. If they do so then they will not be liable in nuisance for the inevitable result of operating Mogden STW taking into account what is possible in terms of scientific knowledge at the time, practical feasibility and expense. As Lord Wilberforce said in Allen, at 1011F, it is well settled that where Parliament by express direction or by necessary implication has authorised the construction and use of an undertaking or works, that carries with it an authority to do what is authorised with immunity from any action based on nuisance. Allen negligence is therefore an exception to that principle. What is being considered is the obligation of Thames Water to carry out work and conduct the operation at Mogden STW with all reasonable regard and care for the interests of other persons. What is "reasonable regard and care" will take into account such matters as what is possible in terms of scientific knowledge at the time, practical feasibility and expense.

807. I do not consider that this element of negligence in carrying out work or conducting operations at Mogden can easily be extended to a duty to apply to Ofwat for funding for work or projects at Mogden STW with all reasonable regard and care for the interests of other persons, including the Claimants. This, in my judgment, would be a new and major extension of negligence liability which, in principle, could open up claims by customers whose bills were increased by negligent applications or claims by a wide range of people, who might suffer if a water company does not apply for funding with reasonable regard and care for their interests. Such an extension cannot, in my view, be justified on the basis of the nuisance exception in Allen. It seems to me that any such duty would have to arise, if at all, outside Allen. The only possible route would a duty of care arise at general law under the principles of Hedley Byrne & Co Ltd v Heller & Partners Ltd [1964] AC 465. However, there is no possible way in which the Claimants could, in my judgment, bring themselves within the scope of persons to whom a duty might be owed under those principles and indeed the contrary was not pressed by the Claimants.

808. In any event, even if Thames Water did owe such a duty under Allen, I consider that Thames Water have established through the evidence set out above that they did apply for funding to Ofwat with all reasonable regard and care for the interests of other persons, including the Claimants.

809. For the AMP2 Period I accept that Thames Water had pressed Ofwat to grant additional sums for odour control. It can be seen from Thames Water's Strategic Business Plan of 8 March 1994 submitted to Ofwat that they stated that they would "seek to minimise odour problems arising from sewers and sewage treatment works by... carrying out properly planned remedial works at sites with known odour problems". They said that the AMP2 Odour Control Project had identified the need for a relatively small investment provision in the 10 years from 1995. They said that some £3.9m had already been allocated and a further £8.4m had been identified for the 5 year period to 2000.

810. The general policy adopted by Ofwat, as set out in their report in July 1994 on the outcome of PR94 was that enhanced service levels, which would include odour control measures, should be achieved without higher prices. Where water companies had proposed enhanced service above the levels which could be achieved without higher prices the policy was that customers would only be expected to finance these where the water company had made an exceptionally strong case. The report said that the director had concluded for many water companies that there was neither a pressing need nor sufficient evidence of collective customer support. It stated that the exceptions mainly related to sewer flooding where allowance had been made.

811. In such circumstances, whilst Thames Water's funding submissions made for odour reduction in the AMP2 period were not focussed on Mogden STW, they sought funding for odour control which was not granted by Ofwat on the policy that they would not fund enhanced service levels. I accept Dr Spillett's evidence that the AMP 2 submissions were not based only on odour complaints received and this is borne out by the reference to carrying out surveys in the Strategic Business Plan. On the evidence put forward by Thames Water, I am satisfied that their application to Ofwat for funding for odour control

work in the AMP2 Period was made with all reasonable regard and care for the interests of other persons, including the Claimants.

812. For the AMP3 Period I accept that Thames Water put forward a case in the Strategic Business Plan to obtain additional funding to combat odour, including funding for work at Mogden STW which would have commenced in 2000. Within their Strategic Business Plan Thames Water set out that there was a programme to alleviate odour problems relating to recent development encroaching their sites. They also included a section which dealt with odour control from sewage works, including Mogden STW. They sought £9.9m over and above the £7.2m which had been included in capital maintenance in the AMP2 Period.

813. It can be seen from the Ofwat final determinations in 2000 that quality and environmental improvements were identified in such matters as drinking water quality and the water environment in the form of wetlands, inland waters, estuaries and coastal waters. In relation to other enhancements, sewer flooding and low water pressure were seen as being matters where funding allowances were made, However the view was taken by Ofwat that much had been achieved in relation to other improvements over the past five years without any specific allowance in prices and that it did not consider that prices needed to be increased to allow for other improvements to customer service levels proposed by water companies. As Mr Day confirmed there was no allowance for service level improvements in relation to odour which was in accordance with the general Ofwat policy.

814. Thames Water's funding submissions made for odour reduction in the AMP3 period included as a priority in the first year odour control work at Mogden STW but this funding was not granted by Ofwat on the policy that they would not fund enhanced service levels. I consider that in the context of making the application for funding Thames Water acted reasonably in their approach to seeking funding for odour control at Mogden STW. I am satisfied that Thames Water's application to Ofwat for funding for odour control work at Mogden STW for the AMP3 Period was made with all reasonable regard and care for the interests of other persons, including the Claimants.

815. However, even if I had found that Thames Water owed a duty and breached that duty, I am far from satisfied that if, on that premise, Thames Water had made stronger submissions to Ofwat they would have obtained funding for major works or major projects to reduce odour at Mogden STW. The policy of Ofwat in the determinations for the AMP2 and AMP3 Periods was not to allow service enhancements to be funded except for the exceptions which they mentioned, such as sewer flooding. In such circumstances the likelihood is that such funding would not have been granted, whatever the submissions made by Thames Water.

816. The Claimants seek to gain comfort from the decision in Allied Maples but I do not consider that this is a case where that principle applies. First, the concept of a real chance applies to the quantification of damages to reflect that chance, where a party has suffered

loss and its damages depend on the action of a third party. Here the Claimants' damages for nuisance do not depend on Ofwat's actions. Here the chance was that Thames Water might obtain sufficient funding from the third party, Ofwat, to allow them to carry out capital work. Unless Thames Water had obtained all the funding, not a percentage of it, then they could not have carried out the capital work and thereby avoided the nuisance. This is simply not a case where the concept of a real and not merely speculative chance in Allied Maple can be applied by the Claimants so as to establish a claim in nuisance. Secondly, in any event this is a case where, on the evidence, the chance was merely speculative.

817. As a result, the claim that Thames Water failed and neglected to press for capital funding for odour related expenditure within the AMP system prior to 2004 fails.

Particular of Negligence 2: The Claimants alleged that there were the following failures by Thames Water:
(a) Failure to consider drawing on sources of funding other than customer charges or adopting other funding mechanisms so that a nuisance from works persists is negligent in the context of an Allen duty of care.
(b) Failure to draw on sources of funding other than customer charges so that a nuisance from works persists is negligent in the context of an Allen duty of care unless it can be shown that to draw on such sources would result in placing the Defendant in severe financial difficulty that would affect the financial viability of the Defendant.

The Claimants' submissions

818. In the introduction to this Particular of Negligence, the Claimants refer to paragraph 3.4 of the DEFRA "Code of Practice on Odour Nuisance from Sewage Treatment Works" which states:

> "*In addition, operators have access to a variety of funding mechanisms apart from "additional funding" through customer bills, e.g. reallocation of resource priorities, efficiency gains, borrowing and profits. Regulated sewerage companies may need to fund abatement measures and invoke the regulatory price adjustment mechanisms that may be available to them.*"

819. The Claimants also rely on what they pleaded in paragraph 10 of the Reply that Thames Water should set out the extent to which they considered such funding mechanisms and explain why they were not pursued.

820. In relation to paragraph (a) of this Particular of Negligence, the Claimants submit that Thames Water's failure to consider deploying other funding mechanisms, such as borrowing, is a breach of Thames Water's Allen duty if, by deploying other funding methods, Thames Water could have resolved an odour nuisance caused by their negligence.

821. In relation to Thames Water's submission that if the company invested outside the regulatory process it would mean shareholders taking a lower dividend than Ofwat had decided was appropriate, they submit that Ofwat does not decide Thames Water's dividends and in any event they refer to the fact that Thames Water spent £300,000 in 1995-2000 on projects not funded by Ofwat and this was money which Thames Water chose to spend out of its own resources.

822. Further, the Claimants refer to the cost savings from the UWWTD Scheme and submit that there is no evidence that Thames Water considered using these capital efficiency funds for odour abatement works at Mogden STW or to remedy the failure of that scheme once the failure became apparent.

823. In relation to paragraph (b) of this Particular of Negligence, the Claimants submit that at no time had Thames Water spent moneies they received from the sale of land, capital efficiency or profits on odour control works at Mogden STW. They say that Thames Water have not borrowed or otherwise sought funding for this purpose and that the only funding for odour control at Mogden STW has come from customer bills.

824. The Claimants refer to the evidence of Dr Spillett that Thames Water did spend its own money on improvements at Mogden STW. They submit that, on the evidence, Dr Spillett was referring to projects 50WC and 3YMB, both projects being subject to funding from the capital maintenance budget which is derived from customer's bills.

825. The Claimants also refer to the DEFRA Code of Practice on Odour Nuisance from Sewage Treatment Works which states:

> "*In addition, operators have access to a variety of funding mechanism apart from 'additional funding' through customer bills, e.g. reallocation of resource priorities, efficiency gains, borrowing and profits. Regulated sewerage companies may need to fund abatement measure and invoke the regulatory price adjustment mechanism that may be available to them*".

826. The Claimants refer to Mr Day's evidence on Day 18 that if such sources of funding were used by Thames Water this would not be inconsistent with the statutory scheme. They say that this was supported by Mr Cranshaw's evidence that Thames Water would always prefer to make a robust argument towards funded investment but that, if they did not succeed, then Thames Water would fund the works themselves. Further they refer to Dr Spillett's evidence on Day 16 where he gave examples of cases where Thames Water had spent their own money in the expectation, not always realised, that Ofwat would recognise that expenditure in due course.

827. The Claimants say that the reference to regulatory price adjustment mechanisms in the DEFRA Code of Practice were confirmed by Mr Crathorne on Day 11 to be the process of "logging up" available in the AMP2 and AMP3 periods. They say the Code of Practice correctly sets out the position and they submit that, if that were not the position then, for instance, Magistrates could not make Abatement Orders because the issue of whether

capital sums should be expended on plant to abate any nuisance would not be justiciable. If those issues are justiciable in the Magistrates' Courts, the Claimants submit that they should also be justiciable in the High Court.

Thames Water's submissions

828. Again, Thames Water say that these are not, on their own, sufficient to constitute an allegation of Allen negligence because any omission to "*consider drawing on sources of funding*" or to "*draw on sources of funding*" would not by itself have prevented any relevant odour nuisance. Insofar as the Claimants rely on this Particular of Negligence in combination with other allegations of Odour negligence, Thames Water say that the real question is whether those claims are made out.

829. In any event, Thames Water submit that this complaint fails to reflect the basis on which Ofwat determines prices. Thames Water refer to section 2(2A)(c) of the Water Industry Act which provides that it is the duty of Ofwat, among other things, "*to secure that [undertakers] are able (in particular, by securing reasonable returns on their capital) to finance the proper carrying out of those functions*". Thames Water state that, as Dr Spillett and Mrs Newman said, pursuant to s.2(2A)(c) one of the factors that Ofwat takes into account in determining prices is RCV.

830. Thames Water rely on Dr Spillett's and Mrs Newman's evidence that water companies cannot readily spend money on capital assets without Ofwat's approval because of the risk that they will not be able to earn a rate of return on that money so that Thames Water and their shareholders would end up funding such works in perpetuity. Thames Water also rely on the evidence served by the Claimants from Mr Spain, who they initially proposed to call as a funding expert.

831. Thames Water submit that the statutory requirement to make a reasonable return on capital is fundamental to the statutory scheme and cannot simply be ignored when assessing the question of the reasonableness of Thames Water's actions so far as funding is concerned. Unless an undertaker can make a reasonable return on capital it cannot finance the proper carrying out of its functions and Thames Water submit that the statutory requirement imposed on Ofwat by section 2(2A)(c) is inconsistent with the notion that undertakers should be required to finance the proper carrying out of their functions from resources other than returns on their capital.

Decision

832. I accept that, as Thames Water submit, neither of these allegations would, on their own, be sufficient to constitute an allegation of Allen negligence but would need to be linked to an allegation as to drawing on sources of funding to fund some particular project or work which would have prevented any relevant odour nuisance. It is then that other particular of negligence, the carrying out of the particular project or work which would then form the real issue.

833. I have the same concerns as set out under Particulars of Negligence 1 in relation to this being an aspect of Allen or any other cause of action in negligence. But, in any event, if

Thames Water are under no obligation under the statutory scheme to carry out major work and major projects I see no basis on which it can be alleged that they are obliged to spend money to carry out major work or major projects.

834. In my judgment, these allegations even if made out would not overcome the justiciability problems inherent in the claims based on Allen negligence where they relate to carrying out major capital work or projects. Where there are not justiciability problems then, as Thames Water accept in the letter of 8 August 2008, there would be sources of funding available. The difficulty for the Claimants is that the decision on whether a claim is justiciable depends on the statutory regime under which Thames Water operate which involves Ofwat, it does not depend on Thames Water not being able to draw on sources of funding. Those investment decisions by Ofwat do engage s.2(2A)(c) under which Ofwat have to make those decisions in a manner best calculated to ensure that Thames Water are able, in particular, by securing reasonable returns on their capital, to finance the proper carrying out of the relevant functions. That is part of the matters to be considered as part and parcel of the statutory scheme.

835. As a result, the claims that Thames Water failed to consider drawing on or to draw on sources of funding other than customer charges or to consider adopting other funding mechanisms so that a nuisance from works persists, do not succeed and in any event, add nothing to the claims that Thames Water should have carried out work to prevent a nuisance persisting.

Conclusions on Odour Negligence

836. As a result of the matters set out above I find that, in relation to odour, Thames Water failed to carry out the work and conduct the operation at Mogden STW with all reasonable regard and care for the interests of other persons, including the Claimants in:

(1) Failing to treat inlet sewage septicity odours from the inlet works.
(2) Failing properly to deal with Inlet Works Screenings and Grit Removal.
(3) Failing to apply chemical dosing to assist settlement in the Primary Settlement Tanks and Final Settlement Tanks so that Thames Water were compelled to divert flows to storm tanks.
(4) Failing to maintain, operate or replace the system to clean the storm water tanks effectively.
(5) Failing to maintain or replace the necessary pumps, pipework and valves to allow proper emptying of the storm tank hoppers
(6) Failing to maintain or replace the scrapers and scum removal processes for the PSTs/SSTs.
(7) Failing to carry out proper operation, monitoring and maintenance of the OCUs, including failing to act reasonably in setting OCU trigger levels for OCUs;
(8) Failing to carry out consistent olfactometric tests or dispersion modelling.

837. Before I consider the effect of these failures on odour emissions, I shall deal with the allegations concerning mosquitoes.

Allegations in relation to mosquitoes at Mogden

838. It is convenient, first, to review the history of mosquito problems at Mogden STW.

History of Mosquitoes at Mogden

839. The documents appear to show that Cp Molestus mosquitoes were first observed in England in the 1930s at riverside locations in London and were first found at Mogden STW in 1939. In 1943 larviciding was being practised at Mogden STW.

840. In 1985 Dr White, a Senior Lecturer in Medical Entomology at the London School of Hygiene and Tropical Medicine was consulted by LBH concerning a mosquito outbreak at Mogden STW. In a letter dated 8 July 1985 he confirmed his preliminary opinion that the cause of the problem was the mosquito Cp Molestus which was found breeding abundantly in underground tunnels over a wide area at the Mogden Works. He said that the present situation at Mogden represented the most substantial infestation of Cp Molestus detected in the UK for many years. He said that the increasing number of public complaints was representative of a genuinely rising problem. He stated that this should be contained by immediate use of insecticide. He said that current counter measures should reduce the problem to a harmless level and he hoped that it could be totally eliminated during the next winter by means of a thorough insecticidal treatment throughout the underground system at Mogden STW.

841. On 24 April 1986 LBH wrote to Thames Water to say that a recent inspection of the works had revealed a significant area of stagnant and warm water which had not received any attention from Thames Water's staff with regard to insecticidal treatments. It was stated that the area in question lay beneath the walkways of the aeration units, some of which have recently been replaced with gratings.

842. On 25 April 1986 LBH served a prohibition notice under the Public Health Act 1936 on Thames Water Authority.

843. A general picture of the situation in 1986 can be seen from a letter which Dr White wrote to Mr Taylor, the Manager of Mogden STW, on 27 July 1986 Dr White said that he had had meetings and been consulted by Dr Hawkins, TWA's Divisional Scientist, concerning a mosquito problem caused by Cp Molestus infestation at Mogden STW. He said that, when he had written to Dr Hawkins in June 1986, he had felt complacent that no part of the works appeared to be infested following extensive applications of insecticide by TWA's staff and by LBH Operators since mid 1985 when many public complaints were caused by these mosquitoes spreading from the works.

844. Dr White said, however, that during the past couple of weeks more public complaints had arisen and careful inspection by him on 26 July 1986 revealed that extensive areas of infestation with Cp Molestus remained in flooded gullies under slatted walkways between the batteries of aeration tanks. He said that Thames Water staff had been aware

of this area of infestation since April and had undertaken some insecticidal treatment but there seemed to be an inadequate sense of urgency. He said that he could not emphasise too strongly the need to eliminate Cp Molestus from all infested sites through regular weekly treatments as directed by Hounslow Borough Council. He said that his recent visits to Mogden Works had satisfied him that in general the control of mosquitoes had proceeded well and that he found none breeding in the former infestation areas below the sludge digestion tanks, in the sludge pumping station, in gullies alongside the storm water tanks and in the screens complex. Nevertheless he said, the EHO had detected some mosquitoes in these areas and that Thames Water must be vigilant to maintain appropriate control measures.

845. Dr White commented that in 1986 the number of complaints had remained well below the major outbreak in 1985 when more than 100 households had complained. He said that he had hoped that repeated insecticidal treatment over the past year would have eliminated the infestation but unfortunately there was a failure to tackle the infested gullies of the aeration tanks effectively. He referred to a Hounslow Borough Council file which documented outbreaks of Cp Molestus at Mogden Works as far back as 1939. He said that having seen the file, it seemed to him that the Mogden Works became infested soon after its construction since when the degree of counter measures has fluctuated in relation to the perceived problem. He concluded that "*With modern insecticides there is no reason why the infestation cannot be eliminated.*"

846. Following his further involvement in July 1986 Dr White met Thames Water on 20 August 1986 and inspected all parts of the works on 27 September and 25 October 1986. In a letter dated 26 October 1986 he considered that the efforts of Thames Water had apparently eradicated all mosquitoes and that during exhaustive searches he could not find any mosquito larvae or pupae, which led him to think the problem may well be finished.

847. On 31 May 1991 LBH wrote to Thames Water after a visit on 23 May. They stated they had received several reports of mosquito nuisance and during the inspection had found a number of mosquito breeding sites.

848. On 5 September 1991 LBH served an abatement notice on Thames Water in respect of a statutory nuisance under section 80 of the Environmental Protection Act 1990. It stated that they were satisfied that a statutory nuisance existed at Mogden STW arising from "*Mosquito activity causing conditions which are prejudicial to health and a nuisance.*" The notice required Thames Water to carry out measures specified in an attached schedule of work within 30 days of the notice. The schedule of work referred to inspection and recording mosquito activity, eliminating puddles and flooded pits and applying mosquito larvicide or adulticide in appropriate places.

849. That abatement notice was withdrawn on 15 November 1991 after agreement between Thames Water and LBH on a schedule of works for the control of mosquitoes on site. It provided for all areas where Cp Molestus was likely to breed to be inspected at suitable intervals and, where evidence of the existence of the large pupae or adult form was

discovered then eradication measures, as set out in the schedule, were to be implemented within one day which was subsequently, apparently, varied to 48 hours.

850. Thames Water retained an environmental consultancy, Bioscan (UK) Ltd, to carry out mosquito surveys for the purpose of complying with the schedule of works. Bioscan engaged Dr Ismay to carry out the surveys. Dr Ismay and his wife run an entomological consultancy specialising in identification, control and eradication of fly pest species. Dr Ismay has been engaged in dealing with the mosquito problem at Mogden STW for some 19 years, surveying the site once a fortnight in winter and once a week in summer.

851. Thames Water also retained various pest control companies to apply larvicides and pesticides to treat mosquito within 48 hours of the date of inspection, as required by the schedule of works as amended.

852. In 1991 and 1992 Thames Water carried out work to eliminate mosquitoes from the aeration walkways made of wooden boards, which covered shallow sumps where water and organic matter could accumulate forming ideal breeding sites for CP Molestus mosquitoes. The boards were replaced with concrete and the areas filled in with soil.

853. Surveys carried out by Bioscan in the spring of 1992 found mosquitoes in open areas of Mogden STW but these were not considered to be of the human biting type.

854. On 22 January 1993 there was a residents' liaison meeting held at Mogden STW. The main topic of the meeting was mosquitoes and David Howarth, the Works Manager at Mogden, introduced Dr John Ismay who explained that the mosquito which was causing problems in and around Mogden STW was Cp Molestus. He explained the problem of mosquitoes and Mr Steve Board, the dayworks controller at Mogden explained the plan of action which was to inspect, identify and treat in accordance with recommendations.

855. During the 1990s the numbers of mosquitoes at Mogden STW fluctuated. On 26 March 1993 LBH wrote to Thames Water to say they had recently received two complaints of mosquito nuisance from residents living near Mogden STW. On 7 December 1993 there was a Customer Liaison Meeting at which it was stated that there had been virtually no complaints or problems with mosquitoes throughout 1993. There were very few complaints in 1995 and 1996. There were only three complaints in 1998 up to June but the number of complaints increased between June and September 1998.

856. There are references in the documents to various companies being involved in insecticide treatment or removing areas where mosquitoes might breed. From about May 2000 Thames Water engaged Mr Colvin of Greenhunter Limited to carry out routine fortnightly treatments to control mosquito larvae and adults at Mogden STW. Except for a period in 2007, Mr Colvin has been retained by Thames Water since 2000, through various companies (Greenhunter, Cannons and now Bioguard).

857. The treatment methods adopted over the past 10 years, as described by Mr Colvin in his witness statement have consisted of physical control, via removal or modification of

offending habitats; bacterial control, via the use of a larvicide known as Vectobac or Bacillus thuringiensis var. israelensis ("Bti"); mechanical control, via traps, and chemical control, via the sparing use of insecticide use on adults.

858. In Summer 2001 Dr Ismay and Mr Colvin observed an increase in the numbers of mosquitoes at Mogden STW and they say that the sites where mosquitoes were found were treated. This period also coincided with an increase in offsite complaints. In accordance with the schedule of works regular periodic treatment of certain sites at Mogden STW were also being carried out.

859. On 12 July 2001 Mr Colvin wrote to confirm recommendations and charges for additional Cp Molestus control works at Mogden STW which had recently been discussed by Mr Ismay and LBH's Environmental Services Department. He said this:

> "*This year we have unfortunately observed a rapid increase in mosquito activity and consequently a corresponding number of complaints. This had been brought about by a number of factors including (i) early wet spell followed by the recent heat wave leading to high humidity and therefore producing ideal breeding conditions. (ii) larger than usual number of over-wintering adults, (iii) numerous blocked drains, spillages, leakages and building defects leading to many areas of standing stagnant water and (iv) difficulties in treatment of breeding areas such as digesters due to the risk of explosion due to the presence of methane gas.*"

860. On 19 July 2001 LBH served another mosquito abatement notice and the proposed schedule of works attached to this was effectively the same as that attached to the 1991 notice. This notice was subsequently withdrawn.

861. Later in 2001, Thames Water installed electronic fly traps at a cost of around £15,000 and carried out works costing around £25,000 to remove potential mosquito breeding sites. Further fly traps were added in August 2002.

862. On 6 April 2002 Greenhunter produced a comprehensive report setting out methods of mosquito control and on 7 May 2002 Dr Ismay prepared a report on infestation of mosquitoes at Mogden STW. In that report he stated that it was not realistic to expect the total elimination of the Cp Molestus problem from Mogden STW.

863. Dr Ismay has carried out surveys for mosquitoes and their larvae using the same surveying methods, though the way they have been recorded has changed over the period. The time spent on surveying was increased in 2002. At that time, Dr Ismay's recommendations were made orally but in 2002/3 Ms Eccles suggested that these recommendations be put in writing. This was done, initially, in longhand and then in 2003 or 2004 the record was converted into an Excel spreadsheet. Dr Ismay also prepared maintenance and cleaning records.

864. In 2003 Thames Water spent some £60,000 installing insecticutors and carrying out other works needed to remove mosquito breeding sites.

865. On 16 September 2003, following a meeting with Thames Water, Dr Ismay forwarded suggested improvements for the reduction of mosquito breeding sites at Mogden STW. It included reference to a schedule of weekly surveys and to the involvement of Greenhunter. It set out eight areas of engineering works and four areas of maintenance works which were recommended.

866. In July 2003 Greenhunter carried out a summer survey for mosquitoes in the area surrounding Mogden STW and in February 2004 Greenhunter carried out a winter survey for mosquitoes in that area. Those two surveys found that mosquitoes were breeding in the summer at a number of sites outside Mogden STW, including some at a considerable distance away.

867. During the February 2004 survey mosquito larvae were found at two sites and were believed to be Cp Molestus because of their presence in the winter. Adult mosquitoes were found at two sites within the 2 km radius and at another site 5km from Mogden STW. These were thought to be Cp Molestus given the nature of their habitat at that time of year. The populations of Cp Molestus found outside Mogden STW during the winter survey were, I accept, unlikely to have originated from Mogden STW because Cp Molestus do not disperse very far from their breeding site. I accept Mr Burgess' evidence that the human-biting mosquito populations found outside Mogden STW during the Greenhunter winter survey were therefore probably self-supporting populations which did not originate from Mogden STW.

868. In August 2004 the Ismays carried out a detailed study of mosquito infestations in road drains further afield from Mogden STW. This survey found mosquitoes in roadside drains up to 3km away and found that residents were being bitten at that distance. Following that study, in 2005 LBH began regular flushing of roadside drains to remove mosquito larvae. No DNA analysis was done at this stage to distinguish Cp Molestus from Cp Pipiens.

869. In summer 2005 a small number of samples from Mogden STW and the drains in the surrounding area were sampled by LBH and subjected to a new DNA test to establish whether they were Cp Molestus. The results showed that Cp Molestus was breeding in a road drain outside Mogden STW as well as breeding in an underground location at Mogden STW. Other types of biting mosquito are known to breed in the area surrounding Mogden including Culiseta annulata¸ found in 2003 in school ponds; in 2004 in Mr Foord's house; in 2006 in Marianne Welsh's house ("Man biting mosquito identified") and one finding in the 2009 summer survey. Culiseta annulata is an evening-biter, rather than a night-biter like Cp Molestus.

870. In June 2006 Dr Ismay wrote of concerns about the high numbers of sites infested at Mogden STW but said the situation was not as bad as in 2003. He said that several factors had contributed to the recorded increase, being increasing numbers of sites surveyed, the recent very hot weather, extensive building works on many sites, incomplete repair works and maintenance problems.

871. In December 2006 Thames Water carried out Project 974G (Overwintering Works) which cost around £245,000 and consisted of works to remove sites where Cp Molestus breed in the winter. This was the culmination of design work carried on earlier that year. The project was aimed at improvements to access in the digester galleries, drainage improvements, and crack-sealing to remove sources of water. The project followed a proposal in September 2006 which was stated that:

> "***Project Drivers***
>
> ...
>
> *The scope of work to be provided under this project is to remove or reduce some of the significant over-wintering areas at the site. Where it is not practical to remove, the project will improve access to areas of the site to make spraying more effective and hence improve the value gained from the OPEX being spent to control mosquito numbers. Some scope is also required to make the spraying activity safer through improved access provisions.*
>
> ...
>
> ***Project Justification***
>
> ...
>
> *Mosquitoes are able to survive and reproduce readily during the summer but require still, warm water to survive over the winter. Mogden STW has a number of areas that provide ideal over-wintering sites, such as digester galleries, aeration galleries and the main pumping station drywell. This allows a large population of mosquitoes to survive and breed, and impact local residents and staff.*
>
> *With the elimination or reduction of the most significant over-wintering sites, it is expected that the summer nuisance would be decreased and may delay outbreaks. Whilst not eliminating the operational spend, over a number of years a reduction may be expected.*
>
> ...
>
> ***Options***
>
> ...
>
> *CAPEX- a full assessment of all over-wintering activity has been undertaken with consulting entomologists. The level of investment has been challenged and value managed to identify those two areas where CAPEX spent will have high impact on mosquito activity....*"

872. The works were set out in more detail in a specification prepared in draft in September 2006 which set out the objective in these terms:

> "*The objective of this project is to reduce the number of mosquitoes by reducing the number of over-wintering sites. A decrease in the frequency and amount of spraying is also to be expected with the completion of this work. TW's consulting entomologist has identified the main over-wintering sites as the lower galleries between the sludge digestion tanks, the basement of the power house, the galleries at the south ends of aeration lanes 1 to 18 , pumping station 5 just north of the*

sludge digestions tanks and pumping station 4, just south of aeration lanes 6 and 7."

873. By way of example it set out as follows in relation to the digestion tank galleries:

> "*The digestion tank galleries are the worst areas for winter infestation and comprise an upper and lower level. The floors of the upper galleries have openings by each digestion tank. In galleries 2 and 3 these openings have steel Technocovers fitted, with the remaining having a removable steel grating fitted. Sludge spills and constant high temperatures in galleries 2 to 5 create ideal breeding conditions for Culex Pipiens.*
>
> *The 150mm drains for the sampling sinks to each digester are reported to be blocked with concrete and cannot be cleared by the jetting unit. There is also visible debris in the drains for tanks 5, 11, 15, 16, 17 and 19.*
>
> *Galleries 1-3 are directed by sumps, located in the centre of each gallery and connected to a dedicated low-level 150 mm drain. Galleries 4 and 5 presently contain large amounts of stagnant water/sludge and were originally drained by a sump pump in each gallery, which discharged into the sink drains. Flexible 50 mm hosing, which was reported to block frequently, was later installed for each pump to bypass the blocked sink drains and discharged directly into the sump in gallery 3.*
>
> *Both pumps are no longer functional and will be replaced by the Purchaser's Operations Team with submersible pumps manufactured by Flygt ... and using the original 50mm hosing.*"

874. As the Summary continues, high priority areas (remediable at a cost of £150,000) and medium priority areas (at a cost of £100,000) were put into the project, whereas "further work, judged by the team as low priority, has not been costed."

875. Between July and September 2009 the Ismays carried out a survey of Mogden STW and up to 4km radius to see if Cp Molestus was breeding outside of Mogden STW, and to study the distribution of Cp Pipiens. The survey also studied biting patterns within the 4km radius. The samples were analysed using newly available DNA technology at Queen Mary's College, London capable of differentiating the two biotypes, rather than using habitat as in previous surveys.

876. The 2009 Survey showed that:

(1) In relation to the 31 samples taken from Mogden STW, the analysis demonstrated that 16 were Cp Molestus and 13 Cp Pipiens. It was also found that there was an overlap in habitats, with some Cp Molestus found in the open and some Cp Pipiens indoors indicating that the distinction in habitat is not as clearcut as had previously been thought.

(2) In relation to the 118 samples taken offsite and analysed, all, except two, were found to be Cp Pipiens. No Cp Molestus were found in what is traditionally the height of the mosquito season.

(3) In relation to the 97 properties visited, there was no significant difference in the proportion of properties with Cp Pipiens as distance increased from Mogden STW which suggested that Mogden STW did not seem to be the source of the Cp Pipiens found**.** Biting was found at all distances, and there was a similar distribution of frequency and intensity at the distances surveyed.

Overview of Mosquitoes

877. The offending mosquito with which I am concerned is Cp Molestus. However, the commonest mosquito seen at and in the area of Mogden STW is another biotype of the Cp species, Cp Pipiens. It is indistinguishable morphologically from Cp Molestus. Cp Pipiens tends to breed in open, over-ground water bodies, whereas Cp Molestus usually breeds in enclosed areas. As a result, Cp Molestus breeding sites may survive the winter in enclosed areas, whereas Cp Pipiens and their larvae will not last the cold. Textbooks distinguish between Cp Pipiens which bite birds not humans in the UK whereas Cp Molestus bite humans. Cp Molestus lay their first batch of eggs autogenously, that is, without needing a blood meal. An effect of this is that it is not necessary for Cp Molestus to seek a blood meal if their habitat is otherwise suitable for them. Cp Molestus cannot be told apart from Cp Pipiens by visual identification but can be by observations in the field or by breeding and seeing if they need a blood meal before laying eggs. Since 2009 DNA tests have become commercially available to distinguish between them.

878. Thames Water submit that, because of their different behavioural patterns, Cp larvae in the open is probably though not necessarily indicative that the larvae are Cp Pipiens, rather than Cp Molestus and simple observation of mosquito larval activity at Mogden STW, therefore, does not necessarily establish the presence of breeding Cp Molestus.

879. The likely dispersion range of Cp Molestus is not significantly in dispute between the experts. Mr Boase says the range is likely to be in the region of about 1km or up to 1.8km whilst Mr Burgess thought the range would not be likely to exceed 1 km. Whether Cp Molestus go to the full range in any numbers will depend on whether they have any reason to do so.

880. The Claimants allege that Thames Water are liable in respect of the nuisance caused by the presence and biting of Cp Molestus. The Claimants say that these mosquitoes were present in their properties and bit them and that these mosquitoes came from Mogden STW. They say that the presence and biting was sufficient to amount to a nuisance and that it was caused or materially contributed to by Thames Water's negligence in that they should have taken further measures which would have led to the prevention or reduction of the number of Cp Molestus mosquitoes and the bites caused by them.

881. In their closing submissions Thames Water agree that, on the basis of the expert evidence, there is agreement that Cp Molestus mosquitoes bred at Mogden STW probably did bite some Claimants on some occasions. Otherwise they deny that there was a nuisance in law or that they were negligent and should have taken further steps. They say that, as the 2009 survey shows, the Claimants were almost certainly also bitten by insects, which were probably mosquitoes, which did not come from Mogden STW.

882. Thames Water say that whilst they do not contend that Cp Molestus bred at Mogden STW have not bitten those who live near the works, that does not mean that any bite in the environs of Mogden STW can be blamed on Cp Molestus bred there. They submit that remarkably few Cp Molestus have been found offsite consistent with Mr Burgess' view that, generally speaking, they would have little impetus to leave Mogden STW. In such circumstances Thames Water submit that it is for the Claimants to prove that they were bitten by Cp Molestus bred at Modgen STW but that the presence of offsite mosquitoes proves nothing and there is no proof that a Cp Molestus has bitten anyone.

The Points of Negligence in respect of Mosquitoes

883. I now deal with the individual Points of Negligence.

Point of Negligence 1: Thames Water failed and neglected, prior to 1998, to carry out any or any adequate survey of mosquito infestation in and around Mogden STW.

Claimants' submissions

884. The Claimants rely on the evidence of Mr Boase and say that there were no proper surveys carried out prior to 2003 and that it was only when Greenhunter surveys were carried out in 2003-2004 that Thames Water had a proper understanding of the problem.

885. The criticisms made by Mr Boase are, first, that the mosquito larval survey techniques used were insufficient to enable the larvicide to be applied at a time when the larvae are most susceptible. Secondly, he says that the surveys of adult mosquitoes were insufficient to enable the main breeding sites to be clearly defined and the impact of treatments determined. Thirdly, he says that prior to 2003 surveys were much less comprehensive with the result that some larval sites may not have been detected and information of use to the insecticide treatment program was not recorded. Fourthly, he said that no systematic attempt was made to identify the bio type of the mosquitoes present in the various habitats within Mogden STW. He says that as a result, the control effort is likely to have been much less targeted and the prospect for eradication less likely than would otherwise have been the case. He says that although the detail of the survey was likely to have been decided on initially by Bioscan he criticises Thames Water for not having recognised and addressed the shortcomings over time. For instance, he says that they should have reacted to the lack of written recommendations on maintenance and preventive work provided by Bioscan to Thames Water between 1991 and 2001.

886. Thames Water rely on the evidence of Mr Burgess. He has reviewed the documentation on surveys conducted from the 1990s onwards and the pest control measures introduced as a result of these and in response to the actions of the Local Authority. In his view Thames Water have acted responsibly and with due diligence in placing contracts with responsible and respected consultants and operatives to achieve the best outcome for mosquito management at the site. He considers that the allegation that Thames Water have not conducted adequate surveys is without foundation and unreasonable.

Thames Water's submissions

887. Thames Water deny that they were negligent and say that the surveying carried out by Bioscan on their behalf was as efficient as was practically possible and rely on what Mr Burgess says at para 30 of his report and Dr Ismay's evidence at paras 72 to 75 of his first witness statement. Thames Water say that in the pre-1998 period, Dr Ismay spent one day a week in Summer and one day a fortnight in Winter walking round the site, concentrating on key areas which might be potential breeding sites. Thames Water also submit that there is, in any event, no causation because there had not been any significant problem in 1998 or for the few years before. They also say that a wider survey would not have revealed anything further and so, given that the claim period only starts in early 1999, any lack of surveying pre-1998 is irrelevant.

888. Thames Water say that whilst the record-keeping has improved over the years, and the more recent division of the site into sub-areas was sensible, that does not establish that the record-keeping was inadequate before. They submit that Dr Ismay has surveyed the site consistently over the years and knows exactly where the areas are which are likely to show significant activity. It is pointed out that there was close communication between Dr Ismay and Mr Colvin about treatment and between Dr Ismay and Thames Water on engineering/housekeeping responses. In these circumstances, Thames Water submit that it is difficult to see how any of the Claimants' criticisms would have led to any short-term or long-term reduction in mosquito numbers at Mogden STW.

889. In any event, Thames Water say that the criticisms are levelled at Dr Ismay and Mr Colvin, who are both expert consultants, engaged by Thames Water and Thames Water were entitled to rely on those experts and the advice they gave. They submit that, even if those experts were negligent, Thames Water are not vicariously liable for their negligence and they rely on the fact that there is only a limited category of events where liability rests with the principal.

890. In relation to Mr Boase's evidence that the survey should have differentiated between the biotypes Cp Pipiens and Cp Molestus, Thames Water say that whenever larval mosquito activity was detected which warranted treatment, those engaged by Thames Water had to act fast, because if they do not do so they might lose the opportunity that the larvicide would work. Hence, they sprayed all mosquitoes seen, whether or not they are in a habitat generally associated with Cp Pipiens or Cp Molestus. They submit that it is not clear how differentiation of the biotypes would have helped in practice to reduce the number of Cp Molestus at Mogden STW because any treatment would have to be carried out without

waiting until either the breeding experiment or DNA analysis was completed, otherwise the larvae would be mosquitoes on the wing before the results were available.

Decision

891. The evidence of Dr Ismay, which I accept, is that he has been carrying out surveys since 1991-1992 and would spend one day a week in the summer and one day every fortnight in the winter, walking around the site visually checking for the presence of mosquitoes in the form of eggs, larvae, pupae and adults. He says that given the size of the site he could not inspect every single actual or potential breeding site each week. He therefore drew up a list of 15 key sites to survey each week. As he moved around the site he said he also inspected any other places that he considered might be potential breeding sites, for example leaking pipes producing puddles of water. He would then advise Thames Water that these needed to be dealt with. He says that between 1992 and 2002 this remained the regime and the mosquito populations at Mogden STW were under control, with the summer months in some years suffering from outbreaks which were treated. He says that in 2002 further investment into the surveying process was made by Thames Water. Bioscan were contracted to provide two man-days per week in the summer and 1.5 man-days in the winter for the surveying and reporting process.

892. The inspection reports that I have seen from about February 1995 show the areas surveyed and whether there were adult, larvae or pupae infestations together with recommendations. I understand that similar information was provided prior to that date orally. Whilst since 2002 to 2003 the site has been divided up into many more sites and therefore more information is available as a result of the survey, I do not consider that it can be said that prior to 1998 Thames Water, failed to carry out adequate surveys of mosquito infestation in and around Mogden STW. As set out in the documents and having seen Dr Ismay give evidence I consider that the surveys carried out were of a high standard and were adequate to identify any infestations which existed. Dr Ismay also identified where treatment should be provided and I accept that the surveys which he produced were sufficient for others, who were employed to control mosquito infestations, to apply the necessary treatment.

893. In relation to Mr Boase's view that attempts should have been made to identify the bio-type of the mosquitoes present in various habitats within Mogden STW, the approach taken by Dr Ismay and Mr Colvin was that when mosquito larval activity was found they spray all the mosquitoes seen, whether or not that are in a habitat generally associated with Cp Pipiens or Cp Molestus mosquitoes. Given the need to act quickly to apply the necessary treatments I accept Thames Water's submission that no benefit would have been derived from such an analysis. The recent 2009 survey using DNA techniques would, in my view, be a wholly impracticable approach. It would also be unnecessary because treatment of mosquito habitats cannot be determined by the analysis of a number of mosquitoes from each site. Besides the time factor for carrying out the necessary breeding experiments or DNA analysis to identify bio type, the 2009 survey has shown that there is no clear line between the habitats for Cp Pipiens and Cp Molestus and therefore the analysis would not usefully assist in the treatment program.

894. In those circumstances I do not consider that the survey of mosquito infestations in and around Mogden STW prior to 1998 or 2003 can properly be criticised. In any event, I accept Thames Water's submission that they were entitled to rely on the expertise of Bioscan, Dr Ismay, the treatment companies and Mr Colvin in determining what was the appropriate survey to be carried out. It is evident that Dr Ismay did report maintenance and other problems to Thames Water and I do not consider that there were any grounds for Thames Water to take action because of any alleged inadequacies in the surveys.

Point of Negligence 2: Thames Water failed and neglected to carry out the works set out in the Schedule to the abatement notice mentioned in paragraph 33 above and in the letter mentioned in paragraph 34 above prior to 1998. (R.66) The Schedule and letter form Annexes B and C to the Schedule of mosquito nuisance. (R67 & 68)

Claimants' submissions

895. The Claimants contend that Thames Water failed to carry out the schedule of works attached to the Abatement Notice of 19 July 2001. They make criticisms of what Thames Water did in relation to each of the paragraphs. They say that Thames Water failed to cause all areas to be inspected weekly until 2007/2008 and that they did not implement eradication measures within one day where Cp Molestus were found (paragraph 1); that Thames Water failed to keep detailed records of the eradication work in that the records of pesticide application were largely lacking, as stated by Mr Boase in his expert report (paragraph 2); that larvicide was not applied within one working day (paragraph 3); that that Thames Water failed to keep all local drainage systems clear and free running (paragraph 5) and that Thames Water did not regularly review procedures to ensure that the best practical means were being carried out to minimise the activity of Cp Molestus (paragraph 6). They accept that that adulticide was generally applied in accordance with this requirement (paragraph 4).

Thames Water's submissions

896. Thames Water deny this allegation of negligence and say that all the works originally specified in the abatement notice were carried out. They rely on the evidence in Dr Ismay's first witness statement at paragraph 63. In any event they submit that pre-1998 defaults, even if proven, are irrelevant given that the claim period started in 1999.

Decision

897. As I have stated above, inspections were carried out weekly during the summer and at fortnightly intervals during the winter and I consider that this complied with the requirement of paragraph 1 of the Schedule of Works and there is no indication that LBH disagreed with this regime.

898. The eradication measures outlined in that schedule were evidently related to treatment of larvae or mosquitoes with larvicide or adulticide. The criticism here seems to be that, on the evidence of Dr Ismay and Mr Colvin, spraying was carried out within 24 to 48 hours of receipt of the inspection report. There is evidence that the requirement of one day was changed to 48 hours and I consider that on this basis the time provision was substantially complied with.

899. In relation to paragraph 2 of the Schedule of Works, I have seen the detailed records prepared by Dr Ismay which record where treatment should be given. As referred to by Mr Colvin in his first witness statement, records of the treatment applied at Mogden STW were kept on site and I have seen written reports and the pesticide usage log which have been produced since 1995. These, in my judgment adequately record the eradication procedures which have been carried out. In any event, as stated in Mr Colvin's Witness Statement, there were regular audits with the EHOs of the relevant London Boroughs at which any inadequacies would have been dealt with.

900. As to paragraph 3, the Claimants say that if inspections were done weekly, then with larva life cycles at temperatures over 25 degrees of 7 days or less than it was important for larvicide to be applied as soon as possible. As indicated above I am satisfied that, where appropriate, the relevant treatment took place within the amended time period agreed with LBH.

901. In relation to paragraph 5, the Claimants referred, for instance, to Dr Ismay's report of 18 August 2005 where he says that "*Many blocked drains on site, some are infested with mosquitoes.*" I have reviewed the records of Dr Ismay and it is clear that for some items they kept recurring on the maintenance and cleaning reports which were provided by him. I consider that there is evidence that Thames Water failed to keep some local drainage systems clear and free running.

902. In respect of paragraph 6, the Claimants rely on the evidence of Mr Boase that although Bioscan stated that there was constant contact with Thames Water and a protocol was produced in 2009 which mentions "constant review" there is no contemporary document relating to regular reviews of procedures and progress. He refers to occasional meetings. I have read the evidence of Mr Colvin and his reference to the ways in which he has been involved in developing means for treating mosquitoes at Mogden STW. On the basis of those references I am satisfied that through Mr Colvin's various companies the procedures for treating mosquitoes were adequately reviewed so that the best practical means were used to minimise the activity of Cp Molestus.

903. As a result, I do not consider that Thames Water failed and neglected to carry out the works set out in the Schedule to the abatement notice.

904. **Point of Negligence 3: Thames Water failed and neglected to carry out the works mentioned in paragraph 2 of these particulars properly or at all.**

Claimants' submissions

905. This Particular of Negligence is dealt with by the Claimants' submissions referred to above under Point of Negligence 2.

Thames Water's submissions

906. Thames Water deny the allegation of negligence and say that all the works specified in the abatement notice, as revised by agreement with LB Hounslow, were carried out and

refers to Dr Ismay's first witness statement at para 63. Thames Water say that the only potential exception to this was the limited number of occasions when treatment was not carried out within 48 hours of Dr Ismay's survey as access was not always available as Mr Colvin explained in his evidence.

Decision

907. As I said in relation to Particular of Negligence 2, there is evidence that Thames Water failed to keep some local drainage systems clear and free running. With that exception I consider that Thames Water properly carried out the works in the Abatement Notice.

908. **Point of Negligence 4: Thames Water failed and neglected to prevent the said infestation at and around Mogden STW adequately or at all.**

Claimants' submissions

909. The Claimants point to the fact that the infestation remains and rely on Mr Boase's evidence that, despite rounds of inspection and treatment since at least 1991 together with maintenance and engineering inputs, the mosquito population at Mogden STW is still present. Mr Boase says that the level of infestation within Mogden STW fluctuates from year to year but the data shows no clear evidence of a systematic decline. He concludes that Thames Water have not been effectively managing the mosquito control work carried out by their contractors and in-house staff and, as a result, mosquito nuisance has continued at a substantially higher level than would otherwise have been the case.

910. The Claimants also say that there has been no routine evaluation of effectiveness of insecticide efficiency and resistance. In particular Mr Boase criticises Thames Water for failing to evaluate the efficacy of control measures. It is said that, in particular, findings from such analysis of efficacy may have prompted the consideration of alternative, more effective approved products for adult mosquitoes control or Thames Water might have sought approval from the Health and Safety Executive for the use of larvicides not currently approved for use.

Thames Water's submissions

911. Thames Water deny the allegation of negligence and say that whilst breeding sites have been found at Mogden STW as a result of the various surveys, they took all reasonable steps to prevent mosquitoes breeding at Mogden STW or migrating from Mogden STW. They refer to the evidence of Mr Burgess.

912. In addition, Thames Water say that, as set out above and shown by the 2009 survey, there has not been a substantial migration of Cp Molestus from Mogden STW such as to cause a nuisance. Further, to the extent that the Claimants allege that there was a failure to carry out capital works to prevent infestation, Thames Water rely on the Marcic defence.

913. In relation to the possible eradication of mosquitoes at Mogden STW, Thames Water say that the history of the programmes to remove or reduce breeding sites by treatment and the overwintering project to show that they have acted reasonably to eradicate the problem of mosquitoes at Mogden STW. In relation to Mr Boase's view that total

eradication of Cp Molestus at Mogden STW is practical, Thames Water say that this is contrary to Dr Ismay's and Mr Burgess' views. They refer to Mr Boase's evidence on day 17 in the context of the digesters. They say that whilst steps can be and have been, taken to try and minimise organic standing water from the digesters by stopping groundwater flows into the underground digesters, Mr Boase had no basis for his view that complete eradication was practicable as he had no prior experience of working for or advising sewerage undertakers on the mitigation or removal of mosquitoes from sewage works.

914. Thames Water rely on what was said by Dr Ismay that, although it is relatively easy to control numbers to a reasonable level, it is almost impossible to get rid of them. They say that a total eradication project would involve widespread works designed to stop any possibility of creating habitats conducive to the breeding of Cp Molestus and that either on Leakey principles this would not be required or on the basis of Marcic this would not be justiciable, on the basis that it is capital works.

915. In relation to Mr Boase's criticism of the swiftness of response by Greenhunter to findings of activity Thames Water say that Mr Colvin aims to treat within 24-48 hours after Dr Ismay has carried out his survey. They say that this stands the best chance of success and is in line with the agreement with LBH to vary the abatement notice from 24 hours to 48 hours. Whilst there are occasions when the 48 hours cannot be achieved, as for instance in the digester chambers in 2001, Thames Water say that as Mr Boase's own analysis for 2004 and 2007 shows, 95% of sites were treated within 2 days

916. In relation to Mr Boase's criticisms of the choice of larvicide/insecticide, Thames Water say that the underlying problem with Mr Boase's view is that, in the past, only Bti products have been approved for use in the UK. Hence, Thames Water submit that any issues as to larvicide resistance are academic as Mr Colvin can only treat using Bti. In any event, Thames Water refer to Mr Colvin's evidence that resistance to Bti is highly unlikely. He explains problems with a particular batch of Bti in 2003 which his monitoring detected. Mr Colvin also explains that chemical adulticide is little used at Mogden STW because there are very few adults at Mogden STW, regular treatment with synthetic pyrethoid or natural pyrethin based insecticides can induce resistance and Thames Water have concerns at insecticides entering water courses. Thames Water say that Mr Boase's reference to Mr Bull of LBH complaining of alleged inadequacies in consideration of treatments related to 1998 prior to the claim period.

Decision

917. The central issue is whether Thames Water have been negligent in failing to remove the infestation of Cp Molestus from Mogden STW. The approach of Thames Water has been twofold. First they have engaged Dr Ismay to carry out surveys and, through the companies for which he has worked, Mr Colvin to carry out treatment. Secondly, they have carried out works under a number of projects, including the overwintering sites project, in order to eliminate sites where Cp Molestus might breed.

918. I consider that, in practical terms, some infestation by Cp Molestus at Mogden STW is inevitable. The sewage treatment process involves aspects of the process where the combination of water and temperature provides conditions which are conducive to the breeding of Cp Molestus. The eradication of all such areas is, again in practical terms, not feasible. I consider that the overwintering sites project was a reasonable approach for Thames Water to take as have been the other steps to eliminate mosquitoes at the Mogden STW.

919. So far as the treatment of larvae is concerned I consider that treatment with Bti is a reasonable method to have adopted and I do not consider that it was incumbent on either Mr Colvin's companies or Thames Water to seek approval for larvicides which are not currently approved. There is no evidence that the current use of Bti is ineffective or that some other form of larvicide would be more effective. Equally I consider that there are good reasons, as set out by Mr Colvin in his Witness Statement, why adulticides are not generally used. I accept Mr Burgesses' evidence that resistance monitoring, although a desirable practice under appropriate conditions would have been likely to have been inappropriate and not informative in the circumstances at Mogden STW, particularly because the majority of breeding site only harbour CPP and partly because obtaining sufficient putatively undesirable Cp Molestus would require allowing relatively large numbers of insects to survive in order to obtain enough specimens to perform an adequate evaluation. He also says, and I accept, that monitoring for resistance to the larvicide is similarly difficult as, with only a small proportion of larvae at any one time or in any one locality, it is again difficult to obtain enough and then rear to provide a reasonable population at the next generation to make any test reasonably reliable. He refers to an article showing that it is not as simple and cost effective as Mr Boase suggests.

920. Further I am not persuaded that rotation of insecticides to avoid resistance would be effective. As Mr Burgess points out, evidence suggests that rotation does not delay the onset of resistance any more than using one insecticide until it is exhausted and switching it to another. As a result I accept that, as Mr Burgess says, in the absence of any clear indications that insecticide treatment was not working, it was not appropriate to carry out resistance monitoring.

921. As a result, I do not consider that Thames Water failed and neglected to prevent the mosquito infestation at and around Mogden STW adequately or at all.

Point of Negligence 5: Thames Water failed and neglected to make any or any suitable provision to avoid the risk of the said mosquito infestation.

Claimants' submissions

922. The Claimants say that Thames Water should have made suitable provision to avoid the risk of infestation by the removal of breeding sites and they criticise Thames Water for doing little in this respect prior to 2003. They say that some works were suggested in September 2003 but little seems to have been done to have them implemented until at least 2006. They refer to an email from Dr and Mrs Ismay of 14 September 2006 in which they state that they have deleted some problems from the maintenance report,

either because they are long-term and intractable or because they cannot be solved. Although they accept that some of these areas might have been dealt with under the overwintering sites project (Project 974G) the Claimants say that the failure to do works to remove the breeding sites before 2006 was negligent and made a material contribution to Cp Molestus nuisance.

923. The Claimants refer to the digester sinks which were identified as a winter breeding site but were reported as being blocked in 2008 and again in 2009. The Claimants say that those would exacerbate the winter breeding problem. They also say that little consideration has been given to the use of physical measures such as polystyrene beads or water sprinklers.

Thames Water's submissions

924. Thames Water say that work to deal with the overwintering sites was completed as confirmed by Dr Ismay on Day 9. They say that the specification included works to unblock the digester sinks and rely on Mr Glass' evidence.

925. Thames Water say that the fact that sinks were found to be blocked in 2009 proves little and it cannot be shown that any blocked sinks would have impacted on the low numbers of mosquitoes found in 2008 and 2009.

Decision

926. The approach taken by Thames Water from 1991 onwards was to survey Mogden STW and, on the basis of those surveys, carry out treatment of larvae or insects found on the site. The overwintering project in 2006 followed a number of other projects which had the purpose of preventing a mosquito nuisance. The experts are agreed that the electric fly-killers in the digester and elsewhere are unlikely to have contributed much to the overall control and I am not persuaded that the use of polystyrene beads or sprinkler systems would have been any more effective. As Mr Burgees points out polystyrene beads and other physical additives have implications for the operation of equipment and access. Equally sprinkler systems would increase the overall amount of water in the sumps where problems often arise.

927. I consider that the main question is whether Thames Water were negligent in failing to carry out a project, such as the overwintering sites project, before they did in 2006. In particular the Claimants rely on documents in July 2001 and September 2003 as indicating that works should be carried out at those dates. In the document prepared by Mr Colvin in July 2001 he said the recommendation at item 3, to replace the existing solid metal floor panels in pumping station 4 with metal grids similar to those installed around the sludge thickening plant and aeration walkways, was to assist inspection and treatment purposes. This item was then included in the overwintering specification produced in September 2006. Equally there were recommendations made by Dr Ismay on 16 September 2003 which do not appear to have been carried out. In his evidence Dr Ismay confirmed that these were the works which were included within the overwintering site project. He was asked why it had taken from September 2003 to December 2006 to do the work. He said "*This was a long time, admittedly, but then they had to be worked in*

with other engineering works. The engineers had to decide what could be done and then it had to go out to a contractor who could say whether it was feasible, and do costing. So I would not have said that three years for something of this size is unreasonable."

928. In his report produced in September 2003 Dr Ismay listed the engineering/ maintenance work in order of priority of which sites would have the greatest effect on the reduction of the mosquito population at Mogden STW. He listed the following: repair drainage to digester sump 4, repair drainage to main pumping station basement (dry well) and clear debris, fit pumps to storm tanks valve chambers and secondary sedimentation tanks valve chambers, drain bund at Southern end of main pumping station basement, fit pumps to sumps in pre-aeration chambers C, fit pumps to sumps in pumping station 5, repair sampling sinks in digester chambers and fit pump to pumping station 1 sump. In relation to maintenance work he referred to: flushing the storm tanks and inlet channels, maintaining the sumps to the sludge thickening area drains in aeration galleries A, B and C and vegetation in walkways.

929. As an example in relation to engineering works at item 1 Dr Ismay said:

> "*Repair drainage to Digester Sump 4.*
>
> *The drain in sump 4 of the Digesters has been blocked for over 10 years, causing water to back up in sumps 4 and 5 (the latter drains into 4). Frequent leakage of sludge into sump 4 has produced conditions ideal for winter breeding of [Cp Molestus]. This is probably the most important wintering site for the mosquito in Mogden STW. Although regular spraying, together with drainage from the top, have improved the situation, this remains the most important engineering work on site for mosquito control. If the drain was repaired, sumps 4 and 5 could be maintained in a dry condition and winter numbers of mosquitoes would fall to a lower level. We understand that this is difficult to achieve and would be expensive, because the drain is set in deep concrete at the bottom of the digester chambers.*"

930. In relation to maintenance work at Item 1 he stated:

> "*Flushing the Storm Tanks and inlet channels*
>
> *In summer the Storm Tanks and their inlet channels are often left standing for long periods and become heavily infested with mosquitoes. They should be flushed regularly to prevent large mosquito populations building up. It is not possible to spray such a large area effectively, thus prevention of mosquitoes by mechanical means is the only real option for control. The new systems of draining the 'hoppers', which are left wet when the tanks are drained, is useful, but regular flushing is still necessary.*"

931. In my judgment from 2001 onwards it was evident that to takes steps to eradicate or reduce the Cp Molestus population at Mogden STW it was necessary to carry out a number of engineering and maintenance works at the site. As Mr Burgess says in his report at paragraph 35 the construction changes which were made greatly improved the physical aspects to eliminate potential breeding sites and to minimise accumulation of

standing water. Those changes were made substantially as part of the overwintering sites project in 2006.

932. I do not consider that Thames Water were negligent in not carrying out certain of the engineering and maintenance work raised by Mr Colvin and Dr Ismay from 2001 onwards until they were carried out in the 2006 project.

Point of Negligence 6: Thames Water failed and neglected to develop and/or implement a coherent and overall policy to eliminate the said infestation.

Claimants' submissions

933. The Claimants rely on paragraph 8 of the Expert Joint Statement where the experts agree that eradication should have been the aim of the mosquito control work. They also say that "*achieving eradication is challenging if the control program relies mainly on insecticides and in a complex environment such as Mogden STW. Where breeding site elimination is systematically carried out, then eradication is feasible.*"

934. The Claimants refer to Thames Water's contention, supported by Mr Burgess, that eradication of Cp Molestus at Mogden STW was unachievable. Mr Burgess' view was that due to the structure of the Mogden STW site there are some breeding sites that cannot be completely eliminated for operational reasons or reasons of access. Mr Boase, on the other hand, considers that had thorough mosquito and surveying control work been carried out, in conjunction with a systematic program of building and associated works, then it is likely that eradication could have been achieved. The Claimants say that Mr Boase's evidence should be preferred.

935. In response to Thames Water's contention that even if eradication were achieved it would be pointless because of Cp Molestus breeding outside the works, the Claimants say that the threat of a re-invasion of Cp Molestus in this way is low. They point out that no Cp Molestus were found outside Mogden STW in the 2009 survey; Cp Molestus in Mogden STW are highly inbred; there is no evidence of clustering in the area around Mogden STW (save around the site itself); the overwintering sites found in the 2005 survey outside Mogden STW were not extensive; any Cp Molestus breeding outside Mogden STW relates to small, temporary populations that are eliminated each winter by cold weather. They refer to the evidence of Mr Burgess on day 17 where he said his opinion had changed and he agreed with Mr Boase that, very largely, the Cp Molestus populations off site were transient and although he would never say there was no risk of re-invasion, the risk was lower.

936. The Claimants also say that winter breeding sites can be eliminated. They say that work should be possible to eliminate sites provided that proper surveys are carried out before and afterwards to check that the necessary works are done. They say that Mr Burgess' evidence did not raise any particular difficulties in the elimination of overwintering sites, particularly as he had not considered the works carried out as part of the overwintering sites project at Mogden STW.

Thames Water's submissions

937. Thames Water deny this allegation. They say that the strategy devised by those working for Thames Water was and is a sensible and proportionate response to a problem which cannot realistically be eradicated. It is therefore inevitably open-ended.

938. To the extent that the Claimants' case entails an allegation that Thames Water failed to carry out capital works to prevent creating habitats conducive to infestation, Thames Water rely on the Marcic defence.

Decision

939. The question that I have to consider is whether Thames Water were negligent in not seeking to eradicate Cp Molestus from Mogden STW. In my judgment Thames Water acted reasonably both in the surveying and treatment for mosquitoes by engaging Dr Ismay and Dr Colvin to carry out that work. I do not consider that they can be criticised for not carrying out overwintering site works earlier than 2006 nor do I consider that the scope and the extent of the works within the overwintering sites project can be criticised as not being reasonable. Indeed no serious criticism is made of the scope and extent of those works. In the circumstances I consider that Thames Water have carried out the necessary survey, treatment and construction works to seek to eradicate Cp Molestus at Mogden STW and I am not persuaded that there is any particular aspect which Thames Water should have carried out but failed to do so because they were not aiming to eradicate Cp Molestus.

Point of Negligence 7: The mosquito strategy appears to be an open-ended cycle of inputs that clearly does not prevent nuisance occurring. Thames Water should instead aim to resolve the infestation by working on a strategy based on results, not simply on inputs. (Reply, para. 24).

Claimants' submissions

940. The Claimants say that the contracts between Thames Water and Bioscan, Dr Ismay and the various companies for which Mr Colvin has worked, simply require regular inspections and treatment and there are no performance criteria or indicators. The Claimants say that Thames Water appear to have left the problem to their contractors rather than "*taking ownership*" of it and ensuring results such as eradication or the elimination of winter breeding sites. Essentially they criticise Thames Water for not having developed their own expertise to monitor the situation.

Thames Water's submissions

941. Thames Water deny this allegation. They say that the strategy devised by those working for Thames Water was and is a sensible and proportionate response to a problem which cannot realistically be eradicated. It is therefore inevitably open-ended.

942. To the extent that the Claimants' case entails an allegation that Thames Water failed to carry out capital works to prevent creating habitats conducive to infestation, Thames Water rely on the Marcic defence.

Decision

943. In respect of this allegation, I consider that Thames Water engaged well qualified and experienced persons and companies to perform the inspection and treatment work on their behalf. In such circumstances I do not consider that it can be said that Thames Water were negligent in failing themselves to have greater involvement in the process. They engaged others and, as Mr Gardner said in his evidence, Thames Water relied on Dr Ismay and Bioscan to deal with the problem. I consider that, acting reasonably, Thames Water were entitled to rely on those expert third parties and were not negligent in their approach.

The law of mosquito nuisance

944. This requires a consideration of whether, as a matter of law, mosquitoes at Mogden STW are in law a nuisance which gives the Claimants a remedy against Thames Water.

945. I accept Thames Water's submission that, on the expert evidence, biting insects, including mosquitoes, occur "naturally" on land within the United Kingdom and therefore the issue is whether Thames Water failed sufficiently to abate that natural "hazard".

946. I consider that the position is as set out in the decision of the Court of Appeal in Leakey v National Trust for Places of Historic Intrest or Natural Beauty [1980] QB 485 and that, in the circumstances, Thames Water owed the Claimants a measured duty of care in respect of mosquitoes. I accept that a close analogy is Goldman v Hargrave [1967] AC 645 where a farmer who failed to put out a fire in a burning tree struck by lightning, causing damage to neighbours. In my judgment, the tort is nuisance and the test of liability is whether there was negligence and the standard of care is to be shaped by the personal capabilities and circumstances of the Thames Water.

947. I do not consider that this is a case where the issues in Marcic apply because the question arises in the area of common law not statutory duties.

Conclusions on Mosquitoes

948. As a result of the findings set out above, I do not consider that Thames Water are liable in respect of mosquitoes which naturally arise at Mogden STW. Thames Water were not negligent in the way in which they dealt with mosquitoes but exercised reasonable skill and care to deal with the mosquitoes, including Cp Molestus mosquitoes, which might be present or breed at Mogden STW. In any event, I am not persuaded that the Claimants have established, as a matter of causation, that Cp Molestus mosquitoes from Mogden STW rather than Cp Molestus or other mosquitoes from outside Mogden STW have been responsible for the bites suffered by the Claimants. The evidence of the 2009 survey shows that there are Cp Molestus and other mosquitoes living and breeding outside Mogden STW which, if anything, I consider are more likely to be responsible for the bites, given the characteristics of Cp Molestus mosquitoes.

949. Whilst I obviously sympathise with the Claimants who have suffered from bites, this is a case where I do not consider that Thames Water have been negligent in their approach or that, in any event, Cp Molestus from Mogden STW have been shown to be the cause of the problems suffered.

Limitation

950. Thames Water raises a limitation defence at paragraphs 176 to 178 of the Defence. They contend that time generally starts to run from 9 January 2006 (except for Hanifa Dobson, Trevor Whittall and Steven Taylor where the relevant date is 1 March 2005), the date of issue of the claim form in these proceedings. As a result claims in respect of causes of action prior to 9 January 2000 will be statute barred. At one stage the Claimants sought an earlier date based on an allegation of deliberate concealment but this was not pursued in closing.

951. There is a particular limitation defence raised in respect of the claim for lack of funding from non-AMP resources which forms the basis of the Financing Particulars of Negligence 2(a) and 2(b). The Claimants say that Thames Water negligently failed to draw on sources of funding other than customer charges. Thames Water say that this claim was first made by amendment on 4 January 2008 and therefore any cause of action which may have accrued prior to 4 January 2002 in relation to this claim would be statute barred.

952. The Claimants say that this claim was first raised in paragraph 11 of the Reply and that the relevant date is therefore 30 May 2006 when the Reply was served. They also contend that it is not a new claim as it was a further instance of a breach of duty in respect of which the claim was already made and they refer to the decision of the Court of Appeal in Savings & Investment Bank Ltd v Fincken [2001] EWCA Civ 1639.

953. Alternatively, the Claimants say that if it is a new claim for the purposes of section 35(1)(b) of the Limitation Act 1990 then the relevant date is 9 January 2006. They say that the claim arises out of the same facts or substantially the same facts as are already in issue in the original claim for the purposes of section 35(5)(a). In particular, they say that the claim is a response to matters pleaded in paragraphs 76, 82, 83 and 85 of the Defence. They rely on Goode v Martin [2001] EWCA Civ 1899.

954. Thames Water submit, as set out above, that the allegations in Particulars of Negligence 2(a) and 2(b) disclose no independent cause of action in negligence/nuisance unless those allegations are combined with a separate allegation under one or more of the Odour Negligence Particulars of Negligence.

955. It is only if Thames Water are wrong about that so that the allegations are capable of constituting a freestanding allegation of negligence that Thames Water submit that any cause of action in respect of an odour nuisance suffered prior to 4 January 2002 caused by a negligent omission to draw on sources of funding other than customer charges would be statute barred.

956. For the reasons set out above, I have concluded that the allegations in Particulars of Negligence 2(a) and 2(b) disclose no independent cause of action in negligence/nuisance unless those allegations are combined with a separate allegation under one or more of the Odour Negligence Particulars of Negligence. In any event, they arise, in my judgment from substantially the same matters as are in issue in the original claim.

957. As a result, any cause of action in respect of the allegations in Particulars of Negligence 2(a) and 2(b) which accrues after 9 January 2000 will not be statute barred and so there is no special limitation period in respect of these allegations.

Actionable Odour Nuisance

958. In respect of odour I have held that there were a number of breaches by Thames Water of their Allen duty towards the Claimants in respect of the sources of odour. However, I have concluded that there is no breach of the duty in relation to either mosquitoes or the financial negligence claims. I must therefore assess whether the breaches in relation to odour gave rise to actionable nuisance. I consider first the witness evidence and then turn to consider expert evidence before coming to my conclusions as to whether and to what extent there has been actionable odour nuisance.

Witness evidence on the impact of odour

959. The first witness was Sandra Weston. She lives at 2 Windermere House in Summerwood Road, Isleworth which is a first-floor flat in one of three blocks of flats to the South of the STW. She moved into the property in November 2003 having previously lived to the North of Mogden STW as a child from 1987 to 1991 on the Worton Road estate. In the form which was sent round to each of the Claimants so that they could summarise the position in relation to their complaints, she indicated that there was a severe daily problem with odour in April to September 2004 and 2005 and April to June 2006. At other times there was a moderate problem more than once a week in the period from November 2003 until June 2006. She has registered two complaints on the MRAG website and said that she initially had not had access to a computer but when she later had access to one she said she believed that nothing would be done and it was a waste of time and effort to record the complaints. In terms of odour she said it was intermittent but on occasion so severe that it put her off eating and meant that she had to re-wash her work uniform which she left drying on the balcony of her flat because she was afraid that there would be odour in the clothes.

960. I next heard first from Mrs. Hillary Thomson and then from her husband, Mr Ian Thomson. They live at 133 Halliburton Road, St. Margarets, Twickenham which is some 600 yards to the east of Mogden STW on the other side of the Crane River. They live there with their three children, Owen, Carys, and Huw. They moved into the property during December 1995 and complained of odour. On the nuisance table they assess odour as being severe once per week in April to September 1999, 2000, 2001, 2002, 2003, 2004 and 2005 and April to June 2006. At other times between January 1999 and June 2006 they say that the nuisance is mild, less than once per week. Mrs Thomson had registered a

complaint on the MRAG website twice in 2003 and 2005 and once in 2000, once in 2007, twice in 2008 and once in 2009. She said that at first when she tried to complain about the odour she could not find anyone to complain to and she would only complain if the problem was very bad and she had the time to do so. She said she was busy both working and looking after three children.

961. There were witness statements from the three children, in the case of the youngest child, Huw, from Mrs. Thomson. These witness statements supported the evidence which I have set out above.

962. The next witness was Mr. Stephen Taylor. He lives at 66 Weaver's Close which is 100 yards to the north of the STW. He lives there with his wife Mrs Wendy Taylor and their daughter Rhiannon. They purchased the property in 1998, moving in on 31 October 1998. The next day they woke up with the smell of sewage in the house and he says that it became obvious during November 1998 that there was an odour problem in the area. He contacted the London Borough of Hounslow (LBH) in December 1998 but was advised to contact Thames Water directly. Between December 1998 and June 1999 he contacted Thames Water and LBH on various occasions to complain but was advised that the works were undergoing a program to improve maters. He submitted odour logs for the period July to September 1999 at the suggestion of LBH but he said that LBH appear to have mislaid those logs. He started preparing further logs from September 1999 onwards. I have seen the logs which he prepared for September to November 1999 and in July 2000.

963. He says that the odour problem deteriorated significantly in 2001 and that on 30 July 2001 he attended a public meeting organised by Mrs. Dobson and Mr. Andrews with Isleworth councillors. The meeting was attended by about 70 people and it was following this meeting that the residents formed the Mogden Residents' Action Group (MRAG). As a result of further meetings it was decided to submit a petition to Thames Water and on 19 September 2001 a petition with over 3,000 signatures was handed to Thames Water. Mr. Taylor was asked to and provided a witness statement in relation to the proceedings following the Abatement Notice served by LBH on 19 July 2001 upon Thames Water. In June 2002 MRAG set up an email based complaints system which allowed the residents to email a centralised email address with complaints about Mogden. Mr. Taylor provided the details of some 1,600 complaints logged in this way between June 2002 and June 2006.

964. I next heard evidence from Ms Rachel Addis who lives at 95 Worton Road which is about 150 yards from the boundary of the Mogden STW. She has lived at the property since November 2000 and is the sole owner of it. The property is a 2 bedroom, end of terrace property with a rear garden and allocated parking. She had previously lived in Weaver's Close for six months but did not have a garden. She said she spent most evenings out of the flat and did not notice the odour problems whilst living there.

965. In the table she completed she indicated that she had been affected by odour problems between October 2000 and April 2006. She said that the odour nuisance had slightly improved since 2000 but that the odour was a problem over the summer of 2009 and

ranged from mild to very strong and the most problematic months were June and August. She described the odour as "vile" and notably stronger and more constant in the summer months. She said that when the odour is particularly bad it made her feel physically sick and, on occasion, she had felt so nauseous that she had not been able to eat her evening meal. To try and stop the odour getting into the property she said she kept all her windows closed during the day and night. She said that the odour would be so strong that it would occasionally wake her up during the night.

966. She said that she did not feel that she could have friends and family over to visit her house for fear of the odour ruining the evening. She said it was very embarrassing to have guests and for the odour to suddenly be noticeable and to know they will associate my house with the disgusting smell.

967. She said that she has a nice garden with space to entertain family and friends but would not even contemplate having guests over for a barbeque because when the weather is fine there is a particularly high chance that the odour will appear.

968. She said she had tried to improve the odour by buying deodorising products. She referred to her 34 complaints on the MRAG website prior to 2007. She said they only started in July 2003 when she became aware of the MRAG. She said that the smell had to be pretty bad for her to record a complaint as she has a busy life.

969. The next witness was Mrs Susan Ford who lives at 34 Arnold Crescent which is about 300 yards from the boundary of Mogden STW. She lives at the property with her two sons Thomas Bannister, born on 12 January 1993 and James Bannister, born on 20 September 1990. Her former partner and father to her children, Clive Bannister also lived in the property between December 1996 and May 2009.

970. She said that the Property was left to her by her father who died in 1996 and she owns the freehold. The house is semi-detached and has a driveway and a single garage. The Property has a garden both to the front and the back and has double-glazed windows.

971. She had lived in the house with her parents and she referred to an occasion when the odour nuisance was so bad that in 1984 when the Six O Clock Show on London Weekend Television held a competition to find the smelliest place in London which she entered. She said that the odour she has experienced from 1996 is far worse than she recalls experiencing when she lived in the house between 1961 and 1985.

972. She described the odour from Mogden STW as "hideous". She said it was always the same type of odour but the odour varied in severity. She said that the odour was more of a problem for her during the summer months as she likes to keep the windows and doors open. She referred to the table she had completed dealing with the pattern of odour nuisance her family had suffered between January 1999 and May 2006. She said that between 2006 and 2008 she had not noticed an improvement in the frequency of the odour or its severity. She said the odour is not constant; it is an intermittent, recurring problem. She said that even when she closed the doors and windows the smell is able to

seep into the house and she uses potpourri and de-odourisers. She has not kept receipts for these purchases over the years.

973. She said that she had purchased two fans for her sons' bedrooms upstairs and one for the living room downstairs. She said that when the odour is present she cannot use the garden and cannot plan or make arrangements with friends and family to spend time in my garden. She said that during the Summer when her friends visit the house, it can be really embarrassing if the odour is severe.

974. She said she had complained to MRAG about the odour problem and tries to complain when the odour is particularly bad. She said she had been unwell during 2008 and so was unable to register complaints. She referred to complaints she had made to MRAG between 2004 and 2006 and the complaints made to MRAG between January 2007 and August 2009 which were recorded by LBH.

975. I then heard from Mr Paul Fisher. He lives at 5 Worple Avenue, less than 500 yards from the boundary of Mogden STW. He is a Councillor at LBH. He lives at the house with his wife, Shirley. They own the freehold. The property is a three bedroom mid-terraced house with a front and rear garden.

976. They moved into the property in July 1996 and were immediately spending the summer in the garden and noticed the odour. He said that the nature of the odour varied. Sometimes it smelt like cabbage and sometimes it was like rotten eggs. On average, he estimated that he experienced the odour at the property between four and five times per week. During the winter cooler months the odour did not tend to be as severe and he experienced it about once or twice each week. He said that he experienced the odour almost constantly between June and September 2009.

977. He said he tried to ensure that the doors and windows were sealed shut as much as possible to stop the odour coming in, but sometimes it got inside anyway. He said he regularly used plug-in air fresheners to cover up the odour indoors. He said that he no longer invited people to the property for a barbeque as it was embarrassing. He said that washing put out to dry picked up the odour. He said that over the last year or so, the odour was happening very slightly less frequently, but it was still as strong as it had always been.

978. He said that he logged complaints with MRAG when the odour was particularly bad if it was convenient for him to do so. He said that as a Councillor and member of MRAG he is representing the residents. He provided a record of the complaints he made to MRAG.

979. The next witness was Shirley Fisher who gave evidence to similar effect to that of her husband. She said that when she noticed the odour it would very rarely go within minutes but would linger for 2 to 3 hours but has lasted without respite for 3 days. She said that its severity and length was highly affected by what is going on at Mogden STW but the odour was always strong and she would never describe it at any point as being mild.

980. I then heard from Marc Foord who lives at 45 Elmer Gardens about ¼ mile from the boundary of Mogden STW. He lives at the property with wife, Sharon, and their two daughters, Ciara born on 28 May 1999 and Niamh, born on 17 January 2001. He and his wife own the freehold jointly. The Property is a three bedroom, extended end of terrace with a large back garden.

981. He said that they had purchased the property in May 1998. He said he realised how severe the problems was at Elmer Gardens within the first few weeks of moving in. He said that the odour varied from a rotten cabbage smell that was unpleasant to a raw sewage smell that was repulsive. He said that the odour was a day to day occurrence and that the heat in the summer seemed to exaggerate the smell although it could be equally as bad during the winter. He said that he had experienced a severe odour from Mogden at least once each week since he had lived in the house. He added that the odour was unpredictable and was variable in terms of duration and frequency.

982. He said he closed the windows and doors whenever the smell was bad however but that this made little difference. They had used fans to try and clear the air in their home. He said that the odour caused embarrassment when entertaining friends and family.

983. He stated that he used the garden during the summer and if the odour occurred he tried to put up with it for as long as possible but if the odour was unbearable he would go inside closing the windows and doors. He said he would not eat in the garden as the odour was unpredictable and unpleasant when it occurred. He said he was concerned about his wife and young daughters suffering from the odour on, at least, a weekly occurrence.

984. He said that since June 2006 the odour had slightly improved but it continued to be a problem. He had made a number of complaints to the MRAG website by email. He referred to complaints he had made between 2003 and June 2006 and other complaints made since then.

985. The final Claimant to give oral evidence was Sharon Foord. She said that she would describe the odour as one of raw sewage and on some days it was absolutely vile and made her feel physically sick. She said that the smell generally remained in the house all day and it especially seemed to linger upstairs. She said that she remembered that the odours from Mogden were particularly bad in the Summer of 2008 and 2009. She said that the problems have affected the family as they had a big garden with swings and a trampoline and a paddling pool in the summer for the children to use but when the smells are bad the children have to come in from the garden to get away from it. In her evidence she described the conditions on the day of the Site Visit by the Court. She said that there was a terrible smell at about 12:00 to 1:00pm and it was raining. In fact it was dry on that day and no odour was detected.

986. In addition to the witnesses who gave oral evidence, I have read and considered the witness statements of the other Claimants, including the witness statements of the children who live with their parents. They give similar evidence of the odour and its effects on them and their ability to use their houses.

Expert Evidence of Odour Nuisance

987. In the light of my findings set out above I am concerned with particular odour emissions from particular areas during various periods. This means that figures for damages have to be assessed for those elements of actionable nuisance.

988. Mr Peirson in his main report deals with the way in which odour is measured in terms of European Odour Units (ou_E) and concentrations of odour (ou_E per m^3). He explains that of relevance is both the surface area which is emitting odour (ou_E per m^2) and the rate at which odour is being emitted (ou_E per second). He also explains the process of human "sniffers" used in olfactometry to assess the impact of odour. Odour with a concentration of $1ou_E$ per m^3 would be just detected by 50% of a panel of human sniffers within controlled odour free laboratory conditions.

989. Dispersion modelling is then used in order to assess how odour emissions of a known magnitude (ou_E per second) will be dispersed into the atmosphere to predict the likely impact of emissions in the area around the odour source. Dispersion modelling takes account of a range of factors which affect the way in which odours mix and disperse in the atmosphere, including local topography, the nature of the odour release such as a chimney or tank and local weather conditions. These dispersion models calculate concentrations at points on a grid which then allows odour contours to be plotted to show odour concentrations (ou_E per m^3) which are not exceeded for 98% of the time (98th percentile) at each point.

990. The question of what odour concentration (ou_E per m^3) should be used to assess whether a property of the lead claimant has been affected by odour so as to cause a nuisance has given rise to some differences between Mr Peirson and Dr McIntyre. In his report Mr Peirson refers to the draft guidance document produced by the Environment Agency, as revised in 2009, which suggests three benchmark standards: For the most offensive odours, which include wastewater treatment, a standard of a 98th percentile hourly mean of 1.5 ou_E per m^3; for medium offensive odours, such as frying/food processing, a 98th percentile hourly mean of 3.0 ou_E per m^3 and for the least offensive odours, such as chocolate manufacture or coffee roasting, a 98th percentile hourly mean of 6.0 ou_E per m^3. He says that the sewage sector has generally adopted a 98th percentile hourly mean of 5.0 ou_E per m^3 for planning use but he refers to a stricter standard of 0.2 ou_E per m^3 in some planning appeals. I note that OdourNet initially used the "Newbiggin" criterion of 5.0 ou_E per m^3 but later used both 5.0 and the three criteria of 1.5, 3.0 and 6.0 ou_E per m^3.

991. Dr McIntyre deals with these matters at paragraph 2.2.13 of his main report and states that it has not been possible to date to identify, to date, a single "blanket" odour standard for sewage treatment works. He says that the actual odour concentration above which annoyance and nuisance will arise will be site specific and will also be influenced by local meteorological conditions. He refers to the First OdourNet Report in 2002 which found that 98% of the odour complaints were received from locations which experienced an odour concentration greater than a 98th percentile hourly mean of 5.0 ou_E per m^3 which he considers lends weight to this a 98th percentile hourly mean of 1.5 ou_E per m^3

being adopted as a standard. In his third supplementary report Mr Peirson referred to certain Claimants being affected by average exposures in excess of the 1.5 ou_E per m^3 benchmark and added that, in his opinion, this level of exposure amounted to some level of off-site odour nuisance or annoyance. However, in his evidence on Day 13 he said that the 5 ou_E per m^3 figure was commonly used and he had used it in some of his considerations.

992. I have to consider whether the odour which has been caused by particular odours has amounted to a nuisance in law and, if so, to assess damages for that nuisance. It is clear that odour concentrations below 1.5 ou_E per m^3 would not be considered to be a nuisance but I must bear in mind the fact that, on the basis of my findings, there are a number of processes at Mogden STW which Thames Water carry out and which do not give rise to Allen negligence but clearly give rise to odour emissions. It is therefore the additional odour nuisance caused by matters for which Thames Water are liable under Allen which I must consider. Such an assessment has no precise mathematical correlation with odour concentration figures and the application of a particular figure is difficult in this case because there has been no modelling of the odour conditions for which I have held Thames Water liable. I would be reluctant to find nuisance if the odour concentration was only 1.5 ou_E per m^3 but as the odour concentration rises to 5 ou_E per m^3 I consider that this is the area where nuisance from Mogden STW would start and that by the time that 5 ou_E per m^3 or above is reached nuisance will certainly be established.

993. The particular odour emissions for which I have found Thames Water liable are as follows:

(1) Odours from the inlet works and from the inlet works screenings and grit removal to the North of Mogden STW.
(2) Odour from the PSTs/SSTs to the North of Mogden STW
(3) Odour from the Storm Tanks to the East of Mogden STW.
(4) Odour from the OCUs generally to the South East of Mogden STW.

994. I have then reviewed the dispersion modelling carried out by OdourNet and Mr Peirson and the various tables and odour contour lines which have been produced. Including the latest assessment of storm tank use. I have also had regard to Dr McIntyre's reference to the emissions which would have occurred if the processes were uncovered. This shows the extent to which a normal operation will cause odour. Care has however to be taken not to include the good practice effect if in fact the actual effect is less.

995. On that basis I now turn to consider each of the properties affected.

95 Worton Road

996. This property is to the North of Mogden STW. Rachel Addis stated in her witness statement that the odour had improved slightly since 2000 and also again since 2008.

997. The modelling by Mr Peirson indicates ou_E per m^3 figures of 85.4 (2002); 62.5 (2003); 57.9 (2004); 50.5 (2005); 38.2 (2006); 19.2 (2007); 4.6 (2008) and 8.3 (2009). These are

generally consistent with her evidence. I must clearly make an allowance for the fact that only part of the odour emissions have been caused by matters for which Thames Water are liable. However, not all the sources of odour have been modelled. Taking that into account and on the basis of these figures, I have come to the conclusion that there was actionable nuisance from 2002 to 2007 and I consider that given my conclusions on the causes of the nuisance there was also actionable nuisance between 1999 and 2002.

34 Arnold Crescent

998. This property is located to the South-West of Mogden STW. In her witness statement Susan Ford states that the odour is not constant but is an intermittent, recurring problem. Mr Peirson observes that the sporadic nature of odour impact is compatible with the relatively low frequency, some 14%, of winds from the NNE and ENE wind directions which are necessary to carry odours from Mogden STW towards this property.

999. The modelling by Mr Peirson indicates ou_E per m^3 figures of 16.0 (2002); 12.8 (2003); 6.1 (2004); 14.0 (2005); 9.8 (2006); 4.9 (2007); 2.4 (2008) and 2.9 (2009). These are generally consistent with her evidence and the location of the property. Again, making an allowance for the fact that only part of the odour emissions have been caused by matters for which Thames Water are liable and that some sources, particularly OCUs have not been modelled, on the basis of these figures, I have come to the conclusion that there was actionable nuisance in 2002, 2003 and 2005 and I consider that given my conclusions on the causes of the nuisance there was also actionable nuisance between 1999 and 2002.

2 Windermere House

1000. This is a property located further away from Mogden STW towards the South-East. Sandra Weston in her witness statement reported that between January and July 2009 odours had less of an impact than before but when odour does occur, she said that the smell is awful. The winds from the N to NNW have a frequency of some 7 to 8%.

1001. The modelling by Mr Peirson indicates ou_E per m^3 figures of 14.9 (2002); 10.4 (2003); 25.6 (2004); 34.2 (2005); 18.8 (2006); 25.6 (2007); 4.2 (2008) and 7.1 (2009). These are generally consistent with her evidence and the location of the property. Again, making an allowance for the fact that only part of the odour emissions have been caused by matters for which Thames Water are liable and that some sources, particularly OCUs have not been modelled, on the basis of these figures, I have come to the conclusion that there was actionable nuisance in 2002 to 2007 and I consider that given my conclusions on the causes of the nuisance there was also actionable nuisance between 1999 and 2002.

179 Whitton Dene

1002. This property is located to the South-West of Mogden STW further away from it than 34 Arnold Crescent. Mr Edwards, in his statement, reported recent improvements and relatively low frequency of odours and complaints from 2008 though this is not a view shared by Allister Edwards. Mrs Edwards said that the smell was that of a “stale washing machine water discharge”.

1003. The modelling by Mr Peirson indicates ou_E per m^3 figures of 6.6 (2002); 6.2 (2003); 2.3 (2004); 5.0 (2005); 3.9 (2006); 2.2 (2007); 1.2 (2008) and 1.5 (2009). These are generally consistent with the evidence but are clearly indicative of the location of the property and the relatively low wind frequencies. Again, making an allowance for the fact that only part of the odour emissions have been caused by matters for which Thames Water are liable and that some sources, particularly OCUs have not been modelled, on the basis of these figures, I have come to the conclusion that there was only actionable nuisance in 2002 and 2003 and, given my conclusions on the causes of the nuisance there was also actionable nuisance between 1999 and 2002.

66 Weavers Close

1004. This property is located close to the Northern boundary of Mogden STW, closer to it than 95 Worton Road. Mr Taylor does not consider that there has been any reduction in odour. Mrs Taylor refers to very frequent experiences of odours.

1005. The modelling by Mr Peirson indicates ou_E per m^3 figures of 113.8 (2002); 82.8 (2003); 71.7 (2004); 62.6 (2005); 45.7 (2006); 21.9 (2007); 5.0 (2008) and 9.1 (2009). These are generally consistent with the evidence but are clearly indicative of the location of the property. As Mr Peirson observes it is subject to a wide arc of wind directions and will be affected by a range of odour sources from Mogden STW. Again, making an allowance for the fact that only part of the odour emissions have been caused by matters for which Thames Water are liable and that some sources, particularly OCUs have not been modelled, on the basis of these figures, I have come to the conclusion that there was only actionable nuisance in 2002 to 2007 and, given my conclusions on the causes of the nuisance there was also actionable nuisance between 1999 and 2002.

133 Haliburton Road

1006. This property is located to the East of Mogden STW at a location towards the Southern end. Mrs Thomson stated that the odour had decreased in frequency recently. She and her family also describe a “chemical” component to the odours.

1007. The modelling by Mr Peirson indicates ou_E per m^3 figures of 23.7 (2002); 14.0 (2003); 26.5 (2004); 28.0 (2005); 19.5 (2006); 16.9 (2007); 4.3 (2008) and 9.5 (2009). These are generally consistent with the evidence but are clearly indicative of the location of the property. Again, making an allowance for the fact that only part of the odour emissions have been caused by matters for which Thames Water are liable and that some sources, particularly OCUs have not been modelled, on the basis of these figures, I have come to the conclusion that there was only actionable nuisance in 2002 to 2007 and, given my conclusions on the causes of the nuisance there was also actionable nuisance between 2000 and 2002.

97 Mogden Lane

1008. This property is located to the South-East of Mogden STW, close to the site boundary and closer than 86 Summerwood Road. The Spurrells mention intense odours.

1009. The modelling by Mr Peirson indicates ou_E per m^3 figures of 31.7 (2002); 27.2 (2003); 68.5 (2004); 56.4 (2005); 43.0 (2006); 40.1 (2007); 5.6 (2008) and 10.1 (2009). These are generally consistent with the evidence but are clearly indicative of the location of the property and wind direction. Again, making an allowance for the fact that only part of the odour emissions have been caused by matters for which Thames Water are liable and that some sources, particularly OCUs have not been modelled, on the basis of these figures, I have come to the conclusion that there was only actionable nuisance in 2002 to 2007 and, given my conclusions on the causes of the nuisance there was also actionable nuisance between 1999 and 2002.

45 Elmer Gardens

1010. This property is located to the North-West of Mogden STW. Mr Foord stated that odours have reduced since 2006 although Mrs Foord's evidence was different in relation to Summer 2008. In her evidence Mrs Foord stated that, on the day I visited Mogden STW there was a strong odour although no odour was apparent. I have concerns about the correctness of her evidence.

1011. The modelling by Mr Peirson indicates ou_E per m^3 figures of 14.0 (2002); 6.5 (2003); 5.8 (2004); 4.7 (2005); 4.1 (2006); 2.9 (2007); 0.8 (2008) and 2.7 (2009). These are generally consistent with the evidence and are clearly indicative of the location of the property and wind direction. The relatively low frequencies of ESE and SSE winds, which would carry odours in this direction from Mogden, are reflected in the lower modelled impact exposures. Again, making an allowance for the fact that only part of the odour emissions have been caused by matters for which Thames Water are liable and that some sources, particularly OCUs have not been modelled, on the basis of these figures, I have come to the conclusion that there was only actionable nuisance in 2002 and, given my conclusions on the causes of the nuisance there was also actionable nuisance between 1999 and 2002.

86 Summerwood Road

1012. This property is located at the South of Mogden STW further away than 97 Mogden Lane. Mr Bayne and Crystal Allan gave evidence of the odour.

1013. The modelling by Mr Peirson indicates ou_E per m^3 figures of 16.4 (2002); 11.7 (2003); 29.5 (2004); 27.7 (2005); 17.5 (2006); 17.7 (2007); 4.0 (2008) and 7.8 (2009). These are generally consistent with the evidence and are clearly indicative of the location of the property and wind direction. Again, making an allowance for the fact that only part of the odour emissions has been caused by matters for which Thames Water are liable and that some sources, particularly OCUs have not been modelled, on the basis of these figures, I have come to the conclusion that there was actionable nuisance in 2002 to 2007 and, given my conclusions on the causes of the nuisance there was also actionable nuisance between 1999 and 2002.

5 Worple Avenue

1014. This property is to the South-East of Mogden STW. Mr Fisher mentions odours from June to September 2009 and Mrs Fisher considers that there has been no noticeable improvement in the odour situation.

1015. The modelling by Mr Peirson indicates ou_E per m^3 figures of 25.0 (2002); 18.2 (2003); 30.3 (2004); 36.2 (2005); 25.1 (2006); 26.5 (2007); 6.8 (2008) and 10.1 (2009). These are generally consistent with the evidence and are clearly indicative of the location of the property and wind direction. Again, making an allowance for the fact that only part of the odour emissions have been caused by matters for which Thames Water are liable and that some sources, particularly OCUs have not been modelled, on the basis of these figures, I have come to the conclusion that there was actionable nuisance in 2002 to 2007 and, given my conclusions on the causes of the nuisance there was also actionable nuisance between 1999 and 2002.

1016. I shall now consider how the relevant actionable nuisance gives rise to damages in this case.

Damages

1017. I now turn to consider the question of damages. The Claimants contend that they are entitled to special and general damages.

Special Damages

1018. Some of the lead Claimants claim special damages which it is convenient to deal with first. Evidently, any sums for dealing with problems arising from mosquitoes fails.

(1) Sandra Weston's claim for an electrical mosquito device fails.

(2) Stephen and Wendy Taylor make a claim for the purchase of de-odourisers at £200 per year for 10 years. There is no supporting documentation. They have suffered a nuisance because of odour for 9 years and sums spent to overcome the nuisance would be recoverable. I assess a figure of £270 for the recoverable loss.

(3) Susan Ford makes a claim for de-odourisers of £270, at £30 per year for 9 years and for the purchase of 3 fans evidently because of the need to keep the doors and windows shut. There is no supporting documentation. She has suffered a nuisance because of odour for 6 years and sums spent to overcome the nuisance would be recoverable. I assess a figure of £180 for the de-odourisers and £20 for the fans as recoverable loss. Her claims in respect of items to deal with mosquito problems fail.

(4) Phillipa Spurrell claims £1560 at £156 a year for 10 years for de-odourisers. There is no supporting documentation. She has suffered a nuisance because of odour for 9 years and sums spent to overcome the nuisance would be recoverable. I assess a figure of £270 for the de-odourisers. Her claims in respect of item to deal with mosquito problems fail.

(5) Marc and Sharon Foord's claim for mosquito deterrents and lotions for bites fails.

(6) Crystal Allen makes a claim for £336, at £84 per year for 4 years, for de-odourisers and £15 for the purchase of a fan. There is no supporting documentation. She has suffered a nuisance because of odour for 4 years and sums spent to overcome the nuisance would be recoverable. I assess a figure of

£120 for the de-odourisers and £15 for the fan. Her claims in respect of item to deal with mosquito problems fail.

General Damages

1019. I now consider the general damages to which the Schedule A Claimants are entitled for odour nuisance

The Claimants' submissions

1020. The Claimants submit that general damages for nuisance should be awarded either on the basis of actual or notional diminution in value as set out in Dobson v Thames Water Utilities Ltd [2009] 3 All ER 319 at [32] - [35] or by reference to precedent as set out in Anthony v The Coal Authority [2005] EWHC 1654 at [117].In relation to valuation, the Claimants rely on the values provided in Mr Dickinson's evidence.

1021. In relation to precedent, the Claimants refer to the decision of Simon J in Watson v Croft Promo Sport Ltd [2008] 3 All ER 1171 where, at [110] he awarded £2,000 a year for noise from a motor racing circuit for the worst affected home. The Claimants submit that any annual award made to them should be double that amount for the most serious cases for a number of reasons. First, in Watson the track was used for racing for 140 days and the claimants accepted as reasonable the use of the track for 40 days. They were therefore complaining of noise for 100 days whereas here the Claimants say they might suffer a nuisance on any day and do not consent to it.

1022. Secondly, they say that motor racing takes place at set times during the day whereas here there may be a nuisance at any time of day or night. Thirdly, they say that there are no physical effects following the noise in Watson whereas here mosquitoes bite the Claimants and sleep is disturbed by odour or mosquitoes. Fourthly, in Watson the nuisance could be anticipated and arrangements for parties and other things could be scheduled accordingly, whereas that could not happen here.

1023. As a result, the Claimants submit that damages should be substantially higher than those in Watson.

Thames Water's submissions

1024. Thames Water submit that damages for actionable odour or mosquito nuisance should be based on the quantum of damages of loss of amenity. They refer to the awards of damages in the following cases. First, they rely on Milka v Chetwynd Animal By-Products (1995) Ltd (2000) where His Honour Judge Diehl QC awarded the claimants £1,000 per year for living near a knackers/animal rendering plant. They refer to the odour described in that case and the particular findings.

1025. Secondly, they rely on Anthony v The Coal Authority [2005] EWHC 1654 (QB) where Pitchford J awarded some £1,000 per year or £3,500 in total for each family for almost four years of smoke, dust and a pungent smell of sulphur.

1026. Thirdly, they rely on Watson v Croft Promo-Sport Ltd where £2,000 per year was awarded to owners of a £720,000 house and £750 per year was awarded to the owner of a £400,000 house affected by 100 additional days of motor racing. They refer to the description of the noise at [106] – [110].

1027. Thames Water submit that these decisions indicate that the damages for past loss of amenity should be comparatively modest. They say that any awards to specific claimants should reflect these factors: (a) their period of occupation; (b) the nature of the properties in which they were living; (c) the nature and intensity and frequency of the *actionable* odour and/or mosquitoes to which they were exposed which will be, in part, a function of the proximity of their properties to Mogden STW and (d) the nature and intensity and frequency of the odour and/or mosquitoes to which they would have been inevitably exposed, if Thames Water had used all reasonable care, and reflecting the parts of the odour claim which are non-justiciable
.

1028. Thames Water submit that, reflecting these matters, damages for each household would be relatively modest. They say the applicable sum will turn on what odour the residents would have been exposed to in any event. On this basis, they say that even if Mr Peirson were right in his view of Good Practice Emissions without covers, damages should reflect the odour which would inevitably have been suffered at the properties of the various Claimants, assuming no negligence.

Decision

1029. In determining Issues 6, 7 and 8 in the First Judgment, dealing with the basis on which damages are to be assessed, I summarised the position on the award of damages for nuisance as follows:

(1) That damages awarded for nuisance, where there has been personal discomfort, are assessed on the basis of compensation for diminution of the amenity value of the land rather than damages for that personal discomfort.

(2) That damages for diminution of amenity value are measured by reference to the size, commodiousness and value of the property not the number of occupiers.

(3) That damages for compensation for diminution of amenity value of the land may be reflected either in diminution of capital value or rental value.

(4) That damages for diminution in value frequently raise difficult issues of assessment which can usually be resolved by expert evidence. If such assessment is not reasonable or practicable then the principles on which damages are assessed are sufficiently flexible to do justice between the parties by arriving at a sum for general damages for loss of amenity.

1030. In considering the principles to apply I also take account of the judgment of the Court of Appeal, on appeal from the First Judgment, where they set out the principles on which damages for loss of amenity may be awarded in the light of the decision of the House of Lords in Hunter v Canary Wharf Ltd [1997] AC 655.

1031. In this case the valuation experts have been able to agree monthly rental values for each of the properties. They do not agree upon the method by which damages can be derived

from those rental values. Neither party sought to call or cross-examine either of the valuation experts. Mr Donaldson considers, in summary, that the values agreed are the same with or without the impact of the nuisance form Mogden STW. Mr Dickenson considers that it is possible to assess a percentage reduction in the rental value to take account of the loss of amenity caused by the nuisance. That percentage differs for each property based on his view of the matters which were alleged by the Claimants to give rise to a nuisance. The range of reduction was 2.5% to 20%.

1032. I consider that the use of rental values provides a sound basis on which to assess damages for loss of amenity. Obviously there will be a range of values which valuers may put on a property and the loss of amenity will generally be a small percentage. It follows that it will be difficult by valuing properties to assess the diminution in value and this, I consider, is the effect of what Mr Donaldson says. I consider though that the general approach adopted by Mr Dickenson is a sound approach, although I consider that figures of 20% would be at the top end of the range in this case, if all of the Claimant's allegations had been made out. As I have stated the odour matters for which Thames Water are liable are significantly less than those on which Mr Dickenson based his values and also liability in respect of mosquitoes has not been established.

1033. On that basis I consider that much lower percentages are appropriate and I have assessed these in the attached table taking into account the extent of the odour nuisance and the fact that some odour does not give rise to a claim. I have sought to place the properties into four groups, ranging from those where the nuisance was most serious to those where the nuisance, whilst still significant, was comparatively the least serious. The percentages I have used are 5%, 3.75%, 2.5% and 1.25%.

1034. In addition, having arrived at an assessment of the sums to be awarded as damages, I have considered how those damages compare to the damages awarded, as set out in the various decisions I have been referred to. I consider that they fall within the correct range for the actionable odour nuisance suffered at the properties.

1035. Accordingly the total sums which I have awarded by way of general damages for nuisance are as follows:

(1)	Hillary and Ian Thomson, 133 Haliburton Road:	£2100
(2)	Rachel Addis, 95 Worton Road:	£4095
(3)	Sandra Weston, 2 Windermere House:	£ 735
(4)	Steve and Wendy Taylor, 66 Weaver's Close:	£4347.50
(5)	Susan Ford, 34 Arnold Crescent:	£1125
(6)	Charles and Judith Edwards, 179 Whitton Dene:	£ 780
(7)	Phillipa Spurrell, 97 Mogden Lane:	£3135
(8)	Mark and Sharon Foord, 45 Elmer Gardens:	£607.50
(9)	Rodney Bayne, 86 Summerwood Road:	£1215
(10)	Paul and Shirley Fisher, 5 Worple Avenue:	£1980
	Total	£20,120.00

Claims under the Human Rights Act

1036. The Claimants listed in Schedule A who have a proprietary interest in their properties claim a declaration as to the violation of their Human Rights and, if necessary, damages for just satisfaction of any breach caused. They also seek an injunction restraining Thames Water from causing any nuisance to them by way of odour and mosquitoes after 31 December 2012.

1037. The Claimants in Schedule B who are mainly the children of the Claimants in Schedule A also seek a declaration, damages and an injunction on the same basis.

The Claimants' submissions

1038. The Claimants allege a breach of Article 8 of the ECHR which provides:

> "1. Everyone has the right to respect for his private and family life, his home, and his correspondence.
> 2. There shall be no interference by a public authority with the exercise of this right except such as is in accordance with the law and is necessary in a democratic society in the interests of national security, public safety or the economic well-being of the country, for the prevention of disorder or crime, for the protection of health or morals, or for the protection of the rights and freedoms of others."

1039. The Claimants submit that if the court finds the nuisances above proved, there has been an actual interference with the Claimants' homes for the purposes of Article 8 ECHR. Further, if there has been an actual interference with the Claimants' homes then they submit that they are victims of an unlawful act for the purposes of section 7(1) of the Human Rights Act 1998.

1040. The Claimants say that if the court finds that the Claimants are victims of an unlawful act that constitutes a breach of their Article 8 rights then the court should make a declaration to that effect.

Damages

1041. The Claimants submit that it is necessary for the court to award damages to the Schedule B children Claimants, even if their parents have received damages in nuisance.

1042. They refer to the First Judgment in this case where I said at [226]:

> "I consider that, where such damages are to be awarded to an individual, the measure of non-pecuniary damages for a victim of a human rights violation in this type of case is damages for inconvenience, mental distress and physical suffering, taking into account all relevant circumstances including factors such as age, the victim's state of health and the duration of the situation complained of, together with any special damages that can be proved".

1043. They say that for most Claimants the duration of the nuisance is at least ten years.

1044. They say that a distinction has to be drawn between damages in nuisance for loss of amenity and damages under the Convention for physical suffering and mental distress. For instance, in relation to Thomas Bannister, he describes the effect of mosquito bites and, in particular, the mental distress they cause, the fact that he now uses a mosquito net all year round but it is uncomfortable. The Claimants submit that these matters are personal to Thomas Bannister and he cannot be afforded just satisfaction in relation to them by an award made to his parents for nuisance. Thus it is necessary to make an award of damages to him.

1045. As far as Clive Bannister is concerned, he lived at 34 Arnold Crescent between December 1997 and June 2009 but has no legal interest in the property which is owned solely by Susan Ford. He is no longer living with her and there is no guarantee that he would get any of the monies a court might award her in nuisance. In the circumstances the Claimants submit it is necessary to make an award of damages under Section 8 HRA to Clive Bannister.

Limitation

1046. The Claimants submit that the court should exercise its discretion under section 7(5) of the Human Rights Act 1998 and impose a limitation period of six years from the date on which the Claimants commenced these proceedings. They submit that this would be consistent with a limitation period in nuisance under s.2 of the Limitation Act 1980, in practice, they say that this would be 2 October 2000, the date of implementation of the Human Rights Act 1998.

1047. The Claimants submit that a one year period was enacted as the primary period to reflect the fact that most HRA claims concern administrative actions in a similar way to judicial review claims.

1048. They refer to my decision in Dobson v Thames Water at [245] where I said, "I consider that in determining a limitation issue under section 7(5)(b) HRA the court should exercise its discretion, by analogy with section 33 of the Limitation Act 1980, having regard to all the circumstances of the individual claimant. In doing so, one of those circumstances will be the circumstances of the group in a group action. Those circumstances may affect the individual."

1049. The Claimants raise a number of points in relation to the criteria in section 33(3). First, they say that there was no delay in bringing the action as the Claimants acted promptly after the decision of the District Judge in November 2004. Secondly, as Thames Water have, in any event, to deal with claims going back to 1999, there can be no difficulties with adducing evidence in respect of claims that could not be brought before October 2000. Thirdly, the Claimants adopted submissions which they had made at one stage in respect of deliberate concealment under section 32 of the Limitation Act 1980. Fourthly, some Claimants were under 18 and thus under a disability for limitation purposes. Fifthly, that the Claimants acted promptly and reasonably after the District Judge's decision and, lastly, that after that decision they took relevant legal advice.

1050. In addition, in respect of the children Claimants, they submit that the court should take into account the provisions of section 28(1) and (2) of the Limitation Act 1980.

The amount of any damage

1051. The Claimants say that the amount of any award of damages is to be determined in accordance with the principles applied by the ECHR and they refer to s.8(4) of the Human Rights Act 1998.

1052. They rely on the decision of the ECHR in Fadeyeva v Russia [2007] 45 EHRR 10 at [152.2(a)], in which damages were awarded of €6,000for non-pecuniary damages – for interference lasting seven years, amounting to about € 850 per year. They say that whilst it may be argued that the scope of the interference with Mrs Fadeyeva's rights was wider than those here, the Claimants submit that the results, in particular the mosquito bites, were more harmful than anything Mrs Fadeyeva suffered. They submit that, as a result, the amount of damages should be on the same lines as that in Fadeyeva with an award of € 850 per year in the most serious case.

1053. Further, the Claimants say that if a Claimant in Schedule 1 is awarded substantially less than €850 per year in her nuisance action, her damages should be 'topped up' to this amount.

Thames Water's submissions

1054. Thames Water submit that even if any Claimant in Schedule 2 can prove that they have suffered significant inconvenience and annoyance from odour or mosquitoes, such inconvenience or annoyance or extra inconvenience or annoyance over the inevitable was not of sufficient severity to constitute a potential interference with any Article 8 rights. They say that there is no suggestion that such Claimants have suffered any personal or psychiatric or psychological injury as a result of odours or mosquitoes.

1055. Alternatively, Thames Water submit that there was no failure on the part of Thames Water properly to respect the rights of any Schedule 2 Claimant. They say that they sought to do all that they reasonably could to prevent odour and mosquitoes migrating from Mogden STW. However they say that even if the Court were to rule that they should have done more in one or other regard, that does not amount to a failure to respect the rights of the Schedule 2 Claimants. They submit that it does not follow from the fact that something amounts to a tort under the law of nuisance that it amounts to a breach of Article 8 as they are different tests. One, they submit, regulates the rights between neighbours, whilst the other regulates rights between citizen and a public authority.

1056. Thames Water submit, in the further alternative, that any breach by Thames Water of Article 8(1) was justified by Article 8(2) in that Thames Water had statutory authority to operate Mogden STW and were complying with their statutory duty under s.94(1)(b) of the WIA. Again, they say that the fact that the particular activity may amount to a nuisance does not render it unlawful within the meaning of Article 8(2).

1057. Accordingly, Thames Water submit that Thames Water have not committed any unlawful act for the purposes of section 6(1) of the HRA.

Damages

1058. Thames Water submit that even if, contrary to their case, any Schedule 2 Claimants' rights have been violated, it is not necessary to make an award of damages under section 8(1) of the HRA. Thames Water rely on the First Judgment at [211], read in the light of the observations of the Court of Appeal at [45] – [52] (**C/2/18- 20)** and submit that in the event that those with a legal right to occupy the relevant home are awarded damages in nuisance, there is nothing in the circumstances of any of the lead Schedule 2 Claimants such as a "particular consideration" identified by the Court of Appeal at [46] that justifies an award of damages under the HRA.

1059. Finally, in determining whether it is necessary to make an award of damages, Thames Water submit that the Court should bear in mind that alternative remedies were available to vindicate the Claimants' rights, whether by way of a complaint under s. 82 of Environmental Protection Act 1990 or the proceedings brought by the Council under s. 80 of the EPA 1990. Whilst Thames Water acknowledge that the observations of the Court of Appeal at [54] would tend against this submission, if it was otherwise necessary to award Thomas Bannister, or other non-proprietary owners, damages under Article 8, they repeat their submissions, relying on Anufrijeva and Greenfield, set out in the First Judgment at [219] – [221], to the effect that these matters all had to be weighed in the balance in deciding whether damages were necessary. They say that these submissions were accepted by the Court to the extent that it regarded such matters as relevant to the issue of whether damages were necessary to accord just satisfaction.

Limitation

1060. Thames Water refer to limitation issues arising under the HRA, arising out of the fact that the HRA has its own specific limitation period prescribed by statute.

1061. First, in relation to the discretion of the Court, pursuant to s.7(5)(b) HRA, to extend the one-year limitation period if it appears to the court that it would be equitable to allow an action to proceed. Thames Water refer to the First Judgment at [245] in which I held that the reasoning of Sir Michael Turner in Cameron v Network Rail Infrastructure Ltd [2007] 1 WLR 163 should be followed, and that the Court should exercise its discretion, by analogy with s.33 of the Limitation Act 1980, having regard to all the circumstances of the individual C. In doing so, one of the circumstances will be the circumstances of the group in a group action.

1062. Thames Water submit that there is nothing in the circumstances that would make it equitable to extend the one-year limitation period under s.7(5)(a). They say that, by the time that MRAG was formed in July 2001, residents were complaining that Thames Water was in "*breach of Duty of Care owing to residents*" and that "*we are seeking redress.. ".* Proceedings were not commenced or deemed to commence until 2005 or 2006, depending on the C in question. Accordingly, the Cs acquired the relevant knowledge well before the one-year period prior to issue, and they submit that it would

not be equitable to extend the primary limitation period that Parliament has specified for bringing such claims.

1063. The second issue of whether, in a case where the alleged unlawful act or omission relied on was a continuing act or omission, the Court's discretion under s.7(5)(b) should be exercised on the basis of a period of either six years prior to issue by analogy with an action in nuisance under s.2 of the Limitation Act 1980 or the whole time that the Claimant was subjected to the unlawful act or omission but not before 1 October 2000.

1064. Thames Water submit that, in the First Judgment at [252] I determined that the six year limitation period in nuisance may be a relevant factor when considering the appropriate period under s.7(5)(b), and that the court might also take into account the period of time when the Claimant was subject to the interference with his or her rights, excluding any period when the rights did not exist.

1065. However, Thames Water submit that there is nothing in the circumstances of the present case that justifies the court extending the one-year period specified in s.7(5)(a). They submit that any claims for damages in respect of alleged unlawful acts or omissions prior to one year before issue are statute-barred.

1066. The next issue is whether, in the case of minors, the Court should apply the same rules as those in s.28(1) and (2) of the Limitation Act 1980 so that they are treated as being under a disability such that the limitation periods in s.7(5)(a) and 7(5)(b) do not commence until they reach their majority.

1067. In the First Judgment at [259] I determined that the provisions of s.28(1) and (2) of the Limitation Act 1980 may be relevant to the issue but are not determinative of the limitation periods under s.7 of the HRA.

1068. Thames Water submit that the question whether the Court should extend the limitation period, pursuant to s.7(5)(b), in the case of a minor Claimant should depend on whether the court grants, or would have granted, an extension in the case of the child's parents. Since they submit that the circumstances of the present case do not justify any extension being granted to any adult Claimant, they submit that there is no reason why any extension should be granted in the case of a child Claimant. In practice, where, as here, all the children have parents alive and participating in the group action, they say that the decision whether a child would proceed with a claim would essentially depend on his or her parents' decision, and once the parent has decided to proceed, there is no reason why the child's claim should be delayed.

Decision

1069. The first issue is whether, on the basis of my findings there has been a breach of the Article 8 rights of the Claimants.

1070. For the reasons I have set out above I consider that Thames Water have failed to carry out the work and conduct the operations at Mogden STW with all reasonable regard and care

for the interests of other persons, including the Claimants. Because of that they have caused an actionable nuisance and have, in my judgment, caused the Claimants to suffer significant inconvenience and annoyance from odour over that which was inevitable. On that basis, I consider that the acts of Thames Water have been of sufficient severity to constitute a potential interference with the Article 8 rights of the Claimants.

1071. Because I have held that Thames Water failed to carry out the work and conduct the operations at Mogden STW with all reasonable regard and care for the interests of other persons, including the Claimants, it follows in my view that Thames Water failed properly to respect the rights of the Claimants and did not do all that they reasonably could to prevent odour migrating from Mogden STW. They did not do what they should have done as a public authority in relation to the rights of the Claimants.

1072. The fact that Thames Water had statutory authority to operate Mogden STW and were complying with their statutory duty under s.94(1)(b) of the WIA does not mean that Thames Water can escape liability under Article 8(2) for acts carried out by them in circumstances where they failed to have all reasonable regard and care for the interests of other persons when carrying out their statutory duty. Accordingly, it follows that Thames Water have committed unlawful acts for the purposes of section 6(1) of the HRA.

1073. The second issue is limitation. As I said in dealing with Issue 12 at [245] of the First Judgment, in determining a limitation issue under section 7(5)(b) HRA the court should exercise its discretion, by analogy with section 33 of the Limitation Act 1980, having regard to all the circumstances of the individual claimant. In doing so, one of those circumstances will be the circumstances of the group in a group action. Those circumstances may affect the individual.

1074. In relation to the matters relied on by the Claimants, first, they say that they acted promptly after the decision of the District Judge in November 2004. The claim was issued on 9 January 2006 and I consider that this was a reasonable period. Secondly, they say that as Thames Water has, in any event, to deal with claims going back to 1999, the further claims cause no difficulty. I accept that there is no prejudice to Thames Water in being able to defend the claim. Thirdly, in relation to submissions in respect of deliberate concealment, I do not consider that there is any basis for that contention and therefore those matters do not assist the Claimants on this issue. Fourthly, some Claimants were under 18 and thus under a disability for limitation purposes bringing in the provisions of section 28 Limitation Act 1980. Fifthly, that the Claimants acted promptly and reasonably after the District Judge's decision and, lastly, that after that decision they took relevant legal advice.

1075. The general rule is that Proceedings must be brought before the end of one year beginning with the date on which the act complained of took place. In circumstances where the other Claimants had a six year period of limitation for the cause of action in nuisance, I consider that the one year period should be extended. In the case of children under 18 then the statutory provisions in section 28 of the Limitation Act 1980 would postpone the limitation period until three years after they reach 18. In the case of a person

who has no claim in nuisance then I consider that the disparity in limitation periods is not equitable, particularly in the case of a group action.

1076. As I said in dealing with Issue 13 in the First Judgment, the 6 year limitation period may be a relevant factor when considering the appropriate period under s. 7(5)(b). The court may also take account of the period of time when a Claimant was subject to the interference with his or her rights, excluding any period when the rights did not exist. In addition, in relation to Issue 14 in the First Judgment, I said that the provisions would be relevant to but not determinative of the limitation period in section 7(5) of the HRA.

1077. I have therefore come to the conclusion that I should extend the limitation period in this case and should extend it from one year to six years on the basis that I consider the six year period to be equitable having regards to all the circumstances. In fact the period will go back to 2 October 2000 which was the date on which the HRA came into force.

1078. The third question is what damages I should award. This involves consideration of the particular Claimants who are seeking damages. In the First Judgment I dealt with Issue 9 and in that context considered whether damages for nuisance might or do confer a sufficient remedy on those with a legal right to occupy so as to disentitle those living in the same household to a separate remedy. The Court of Appeal, on appeal, held at [47] that at the preliminary issue stage the issue could not be answered except in terms that an award of damages in nuisance to a person or persons with a proprietary interest in a property will be relevant to the question whether an award of damages is necessary to afford just satisfaction under Article 8 to a person who lives in the same household but has no proprietary interest in the property.

1079. In addition, I dealt with Issue 10 and stated that "*The alternative remedies under sections 80 and 82 of the Environmental Protection Act 1990, the complaint to Ofwat under s. 94 WIA and the current abatement notice are all relevant to the issue of whether damages for... those without a legal interest in their homes are necessary to afford just satisfaction under section 8(3) of HRA 1998.*"

1080. In dealing with Thomas Bannister who was under 18 and lived in his parent's house I dealt with his position in Issue 9 which concerned claims by those without a proprietary interest. Thames Water pointed out that, other than that of Thomas Bannister, there are no facts upon which the Court could proceed because none of the five claims by lodgers have been pleaded out and they knew nothing about their circumstances, nor of the position of residents of a retirement or children's home or of foster children. In the case of Thomas Bannister, who was a boy living with his parents, the Claimants had, before me, accepted that an award of damages in nuisance to his parents with a proprietary interest in the home was a matter to be taken into account for the purposes of section 8(3)(a). They were, however, given permission to withdraw that concession on appeal.

1081. At [209] of the First Judgment I said:

> "*I consider that when the court awards damages for nuisance to those with a legal interest that will usually afford just satisfaction to partners and children but that there might be circumstances where they will not. In the case of Thomas Bannister, he lives in the same household as his parents who will receive damages for the loss of amenity of their property. There is nothing in the claim to show that such damages received by the household would not afford just satisfaction as they did for Mrs Dennis or would have done for Mr Marcic. I conclude that those damages would afford Thomas Bannister just satisfaction.*"

1082. On appeal, Waller LJ, giving a judgment with which Richards and Hughes LJJ agreed, said at [45] and [46]:

> "*45. We have considerable sympathy for the judge's conclusion as to Issue 9, i.e. that there should be no separate award under Article 8 to Thomas Bannister. However, in the state of the law which we have set out, we would disagree with the judge that it is possible to give an answer at this stage. If one takes the case of Thomas Bannister as the test case, it seems to us that those representing him can show that he has not, personally, had "reparation" under English law (see Article 41). But we do not think it can be regarded as irrelevant whether his parents recover damages in nuisance or what sums they recover because all the circumstances need to be taken into account in considering whether an award is necessary. Furthermore s.8(3) seems to us expressly to require to be taken into account any remedy granted "in relation to the act in question" and "the consequences of any decision … in respect of that act" without limiting the same to remedies awarded in favour of the person alleging infringement of his rights. The vital question will be whether it is necessary to award damages to another member of the household or whether the remedy of a declaration that Article 8 rights have been infringed suffices, alongside the award to the landowner, especially when no pecuniary loss has been suffered. If, for the reasons explained above in paragraphs 32-34, the effects of the odour and mosquitoes upon Thomas Bannister personally were in practice taken into account in determining the diminution in the amenity value of the property, and therefore in determining the amount of damages awarded to his parents in nuisance, we would regard that as a highly significant consideration when determining whether an award of damages was necessary to afford Thomas just satisfaction under Article 8. In any event the fact of an award to the parents, if made, and its amount, must be a circumstance relevant to whether an award is necessary.*
>
> *46. For these reasons, we do not think it is possible to say until the case has been tried out whether it is just and appropriate and necessary to award some damages to Thomas Bannister if he is to have just satisfaction. For the reasons given, it may very well be that a declaration is sufficient in his case, but it will depend on the judge's findings in relation to his parents and to any particular consideration affecting Thomas. Even if it is thought that necessity be shown, the fact of any award to his parents, and its amount will be relevant as to quantum. It should be noted that in any event damages if awarded on such issues are not substantial.*"

1083. The Court of Appeal considered, first, the basis on which damages in private nuisance are to be assessed as set out in Hunter v Canary Wharf [1997] AC 655. At [31] Waller LJ summarised the position in Hunter v Canary Wharf as follows:

> "*31. The speeches of the majority thus clearly establish that damages in nuisance are for injury to the property and not to the sensibilities of the occupier(s). That is so as much for the case of the transitory nuisance interfering with comfort and enjoyment of the land as it is for the case of the nuisance which occasions permanent injury to the land and to its capital value, or other pecuniary loss.*"

1084. In assessing loss of amenity, Waller LJ said that there might be direct market evidence of loss of rental value but continued at [33]:

> "*Otherwise, it is perhaps inevitable that the assessment of damages for loss of amenity will involve a considerable degree of imprecision. But if estate agents are to assist in placing a value on the relevant intangibles, whether by calculating the reduction in letting value of the property for the period of the nuisance or in some other way, we would expect them in practice to take into account, for the purposes of their assessment, the actual experience of the persons in occupation of the property during the relevant period. It is difficult if not impossible to see any other way of proceeding. As Lord Hoffman observed, the measure of damages for loss of amenity will be affected by the size and commodiousness of the property. If the nature of the property is that of a family home and the property is occupied in practice by a family of the size for which it is suited, the experience of the members of that family is likely to be the best evidence available of how amenity has been affected in practical terms, upon which the financial assessment of diminution of amenity value must depend.*"

1085. At [34] he said that, on ordinary principles, claimants must show that they have in truth suffered a loss of amenity before substantial damages can be awarded. He referred to cases of occupied property and said "*So in this way also, as a matter of practicalities, the assessment of common law damages for loss of amenity to the land is likely to be affected by the actual impact of the nuisance upon the occupier, or the lack of it.*"

1086. He concluded at [35] and [36] by saying this:

> "*35. As a result It follows that the actual impact upon the occupiers of the land, although not formally the measure of common law damages for loss of amenity, will in practice be relevant to the assessment of such damages in many cases, including such as the present where a family home is in question and no physical injury to the property, loss of capital value, loss of rent or other pecuniary damage, arises.*
> *36. In our view not one of the speeches of the majority provides any support for the view that the person who has the right to sue in nuisance is recovering damages on behalf of other occupiers of the property.*"

1087. In relation to damages under the HRA Waller LJ referred to section 8 of the Act and Article 41 of the Convention and said, his emphasis, at [41]:

> "*41. It follows that where a public authority has been found to have acted "unlawfully" the court "may grant such relief or remedy …as it considers just and appropriate". No award of damages is to be made unless, taking account of all the circumstances including any other relief or remedy granted in relation to the same act, the court is satisfied that the award is necessary to afford just satisfaction. In determining whether to award damages, or the amount, the court must take into account the principles applied by the European Court under Article 41. We have underlined what seem to us to be important aspects of the exercise that a court must perform.*"

1088. Waller LJ then referred at [42] to the decision of the Court of Appeal in Anufrijeva v Southwark London Borough Council [2004] QB 1124, approved by the House of Lords in R (Greenfield) v Secretary of State for the Home Department [2005] 1 WLR 673 at [9], where Lord Woolf CJ had summarised the features of an award of damages under the HRA and which distinguished it from an award of damages in a private law contract or tort action. Lord Woolf said at [55]:

> "*55.The following points need to be noted. (a) The award of damages under the HRA is confined to the class of unlawful acts of public authorities identified by section 6(1): see section 8(1) and (6). (b) The court has a discretion as to whether to make an award (it must be 'just and appropriate' to do so) by contrast to the position in relation to common law claims where there is a right to damages: section 8(1). (c) The award must be necessary to achieve 'just satisfaction'; language that is distinct from the approach at common law where the claimant is invariably entitled, so far as money can achieve this, to be restored to the position he would have been in if he had not suffered the injury of which complaint is made. The concept of damages being 'necessary to afford just satisfaction' provides a link with the approach to compensation of the Court of Human Rights under article 41. (d) The court is required to take into account in determining whether damages are payable and the amount of damages payable the different principles applied by the Court of Human Rights in awarding compensation …*"

1089. At [42] and [43] in the Court of Appeal Waller continued:

> "*In the following paragraph Lord Woolf said that in considering whether to award compensation and, if so, how much, "there is a balance to be drawn between the interests of the victim and those of the public as a whole" and that the court has "a wide discretion in respect of the award of damages for breach of human rights". He described damages as "not an automatic entitlement but…a remedy of last resort." Later, at paragraph 66, in discussing the principles applied by the Strasbourg court, he said that the approach is an equitable one and that "the 'equitable basis' has been cited by the Court of Human Rights both*

> *as a reason for awarding damages and as a basis upon which to calculate them"... The Convention serves principally public law aims; the principal objective is to declare any infringement and to put a stop to it. Compensation is ancillary and discretionary. The interests of the individual are part of the equation, but so are those of the wider public.*
>
> *43. This broad discretionary approach to the award of compensation is no doubt the reason for what has been identified by the joint report produced in October 2000 of the Law Commission and the Scottish Law Commission (Law Com No 266) (Scottish Law Com No 180), as the "lack of clear principles [in the Strasbourg case-law] as to when damages should be awarded and how they should be measured". (See paragraph 3.4). All one can say with any certainty is that damages have been awarded for non-pecuniary loss, i.e. for inconvenience and distress, in pollution cases. What is not at all clear is quite how Strasbourg would view claims brought by more than one person in a household and how it would react to the fact that one member of the household had recovered damages for nuisance in the courts of a Member State.*"

1090. As I said in awarding damages for nuisance based on loss of amenity, I had regard to all of the evidence of effects on the family members and took that into account in determining the diminution in the amenity value of the property, and therefore in determining the amount of damages for nuisance awarded to those with a proprietary right.

1091. I therefore turn now to each of the claims by the non-proprietary Claimants:

(1) **133 Halliburton Road:** Owen Thomson (born on 5 May 1993)**,** Carys Thomson (born on 6 May 1996), and Huw Thomson (born 1 November 1999). Each of these Claimants has made a witness statement, Huw's being made by his mother. Owen and Carys explain, among other things, the problems of not being able to play in the garden, the embarrassment of having friends come to the house, the inability to have birthday parties at the house and the difficulty when they are taking exams. Mrs Thomson explains the effect of odour on Huw's sleep and ability to have friends at the house.

(2) **66 Weavers Close:** Rhiannon Taylor (born 10 November 1990) has provided a statement in which she explains the problems with odour since she moved to the house when she was eight. She refers to problems of having friends to stay and of being able to study for exams and, in particular, having to study elsewhere.

(3) **34 Arnold Crescent:** Clive Bannister provided a witness statement but, although Thames Water wished to cross-examine him, he was not called but, as stated above, Thames Water took no point on the admissibility of Mr Bannister's statement but reserved the right to make comment as to the weight to be attached to this statement. He is the former partner of Susan Ford and lived at this property for 12 years from December 1997 to June 2009. His evidence generally reflects

the loss of amenity in the property because of the odour nuisance referred to by the other witnesses. James Bannister (born 20 September 1990) provided a witness statement and Thomas Bannister (born 12 January 1993) provided a further witness statement in addition to the one made in 2006. In their witness statements they explain the difficulty in not being able to use the garden, not having friends to stay, nausea caused by the odour, problems with studying for exams and not being able to have birthday parties at the house. Generally this confirms the evidence given by Susan Ford and Clive Bannister.

(4) **179 Whitton Dene:** Joe Edwards (born 18 February 1992) and Allister Edwards (born 21 August 1985): they explain the difficulty in not being able to use the garden, the embarrassment of having friends to visit, problems with studying for exams and difficulty when a barbeque was arranged at the house.

(5) **97 Mogden Lane:** Charley Spurell (born 24 May 1989) moved to the house when she was nine years old and Jessica Spurell (born 14 January 1991) moved to the house when she was seven years old. They both explain, among other things, the difficulty in not being able to play in the garden and use a paddling pool, the embarrassment of having friends to visit and problems with studying for exams.

(6) **45 Elmer Gardens:** Ciara Foord (born 28 May 1999) and Niamh Foord (born 17 January 2001) each provided a witness statement from Marc Foord, their father, dealing with evidence relating to them. That evidence deals with the general evidence and explains the effect on the girls of the odour and of their ability to use the house and garden as well as the effect on their first communion parties.

(7) **86 Summerwood Road:** This property was owned by Rodney Bayne from 1 August 1983 to 9 August 2006. Casey Allan lived at the house with Mr Bayne, his two children and her mother Crystal Allan from 7 June 2002 to 1 April 2005. Mr Bayne provided a witness statement on behalf of Casey Allan (born 7 June 2002) but only provides evidence about the effect of mosquitoes on her. Crystal Allan has provided a witness statement in which she explains in similar terms to the other witnesses the effect of the odour on her during the time she was staying at the house. Mr Bayne, in his witness statement in support of his claim as a person with a proprietary right, also explains the effect of the odour on the use of the property.

Children living with their parents

1092. In relation to the children living with their parents in the relevant properties, as I have said, I have taken into account all the evidence of everyone occupying the property when considering the loss of amenity damages for nuisance. Applying the principles set out by Waller LJ at [41], on appeal from the First Judgment, the court may grant such relief or remedy as it considers just and appropriate. However no award of damages is to be made unless, taking account of all the circumstances including any other relief or remedy granted in relation to the same act, the court is satisfied that the award is necessary to afford just satisfaction. In determining whether to award damages, or the amount, the

court must take into account the principles applied by the European Court under Article 41.

1093. In this case, in determining the question of whether it is necessary to award damages to the children to afford just satisfaction, I take into account the fact that I have awarded damages for nuisance to their parents and that in doing so I have reflected the whole family loss of amenity. I also take into account the fact that I have made a declaration of rights under Article 8 and of the fact that there are remedies under sections 80 and 82 of the Environmental Protection Act 1990 by way of abatement notices and by way of a complaint to Ofwat under s. 94 WIA which are both relevant to the issue of whether damages are necessary to afford just satisfaction under section 8(3) of HRA.

1094. In taking account of the principles applied under Article 41, I have not been referred to any further decisions than those I considered in the First Judgment and as Waller LJ said at [43] in relation to the principles applied by the European Court under Article 41 "*All one can say with any certainty is that damages have been awarded for non-pecuniary loss, i.e. for inconvenience and distress, in pollution cases. What is not at all clear is quite how Strasbourg would view claims brought by more than one person in a household and how it would react to the fact that one member of the household had recovered damages for nuisance in the courts of a Member State.*"

1095. I also note that there is nothing further as to the particular circumstances of Thomas Bannister other than what I had before me at the time of the First Judgment nor anything which is particular to the circumstances of the other Claimants who are children living in their parents' home.

1096. In all the circumstances, taking account of the matters set out above, I am not satisfied that an award of damages is necessary to afford just satisfaction to those Claimants. I therefore do not award damages under section 8 of the HRA to Owen Thomson**,** Carys Thomson, Huw Thomson, Rhiannon Taylor, James Bannister, Thomas Bannister, Joe Edwards, Allister Edwards, Charley Spurell, Jessica Spurell, Ciara Foord or Niamh Foord.

Other occupiers

1097. There are three other people to be considered: Clive Bannister, Crystal Allan and Casey Allan. In respect of each of these I have to decide whether an award of damages is necessary to afford just satisfaction to them.

1098. In the case of Clive Bannister, he lived with Susan Ford for 12 years and his sons James and Thomas live there. In awarding damages for nuisance to Susan Ford I have taken into account the loss of amenity which has been suffered by Clive Bannister but, in his case, because he did not have a proprietary interest, the damages are not awarded to him. However I consider that those damages are still part of the circumstances that I have to consider in deciding whether an award of damages is necessary to afford just satisfaction to Clive Bannister.

1099. In approaching the question I have to consider the remedies which are available to provide just satisfaction to Clive Bannister. As Lord Woolf said in Anufrijeva damages

are not an automatic entitlement but a remedy of last resort. The principal objective of the Convention is to declare any infringement and put a stop to it. The interests of an individual, rather than the wider public, are only part of the matters for consideration. The concept of just satisfaction is therefore a concept which has to be distinguished from the right to damages awarded for breach of common law obligations.

1100. Clive Bannister stated in his witness statement that he felt that Thames Water had not fulfilled their duty to the residents around Mogden STW which reflects the wider concerns. He fairly points out, though, that he is pursuing his claim separately on the basis of the detrimental effect which the odour had on his home and personal life for a significant period of time. As was pointed out by Waller LJ the European Court has awarded damages for non-pecuniary loss for inconvenience and distress in pollution cases.

1101. I have to take into account all the circumstances. In this case those include the declaration of infringement, the remedies available under the sections 80 and 82 of the Environmental Protection Act 1990 by abatement notices and by way of a complaint to Ofwat under s. 94 WIA, the fact that damages have been awarded for nuisance and the fact that Clive Bannister lived at the property as a family member. On balance, I am satisfied that in those circumstances an award of damages is not necessary to afford just satisfaction to Clive Bannister.

1102. In relation to Crystal Allan, she was living with her daughter, Casey, as a family member at 86 Summerwood House. Mr Bayne stated in his witness statement that he lived in the house with his twin daughters and that Crystal was a close friend and he cared for her and Casey as if they were his own daughters. Mr Bayne's witness statement deals with the problems of mosquitoes for Casey but mentions nothing about any particular effect of odour on Casey who was born on 7 June 2002 and lived at the house from her birth until 1 April 2005 when she was nearly three years old.

1103. As I stated in relation to Clive Bannister, one of the relevant circumstances is that Crystal Allan and Casey were living with Mr Bayne as family members and I consider that, in that context, the fact that an award of damages for nuisance has been made to Mr Bayne is also relevant. As with Clive Bannister I take into account the other circumstances which include the declaration of infringement and the remedies available under sections 80 and 82 of the Environmental Protection Act 1990 by abatement notices and by way of a complaint to Ofwat under s. 94 WIA. Again, on balance, I am satisfied that in those circumstances an award of damages is not necessary to afford just satisfaction to either Crystal Allan or Casey Allan.

1104. It follows that I do not award any damages for breach of Article 8 in the particular circumstances of this case.

The Claim for an Injunction

1105. The Claimants seek an injunction in the following terms: to restrain Thames Water by itself, its servants or agents from causing or continuing a nuisance from Mogden STW (the Works), other than is the inevitable consequence of the Works being operated without negligence, by way of odour and mosquitoes to the Claimants herein after 31 December 2012.

The Claimants' submissions

1106. The Claimants rely on Mr Peirson's evidence that unless further works are done there will continue to be a nuisance from Mogden STW, They submit that the injunction does not need to set out detailed terms as an injunction simply saying "No more nuisance by the end of 2012" is sufficient and they rely on the decision in R v Falmouth & Truro Port Health Authority Ex p. South West Water Ltd [2001] QB 445 at 462E to 469G.

1107. Whilst the Claimants accept that the Falmouth case was concerned with statutory nuisance, they submit that the underlying principle is the same. They say that the court can exercise its discretion either by making a detailed order or by simply saying abate/stop the nuisance within a certain period of time. They accept that it may be fairer and more convenient for Thames Water if they are simply told to stop the nuisance by 2012.

1108. The Claimants also submit that, given that the case involves Human Rights, the ECHR does not specify measures but simply requires an end to the breach. They refer to the decision of the European Court of Human Rights in Ledyayeva v Russia [2006] ECHR 896 where they said at [117]:

> "*As regards other applicants, the Court notes that they are still residing within the zone. The Court notes that the resettlement of them in an environmentally safer area (a measure sought by the applicants before the domestic instances) would be only one of many possible solutions. The Court is conscious that there are other possible ways of reducing the negative effects of the plant's activities on those who, like the applicants, reside in the vicinity of it. Therefore, given the complexity of the situation, and in line with its approach to Fadeyeva v Russia [2005] ECHR 55723/00, the Court will not prescribe any particular legal, administrative or other measure to be adopted by the Government. According to art 41 of the Convention, by finding a violation of art 8 in the present case, the Court establishes the Government's obligation to take appropriate measures to remedy the applicant's individual situation. Subject to monitoring by the Committee of Ministers, the respondent State remains free to choose the means by which it will discharge its legal obligation under arts 41 and 46 of the Convention, provided that such means are compatible with the conclusions set out in the present judgment (see Scozzari and Giunta v Italy [2000] ECHR 39221/98 at para 249), in particular, with the two alternative solutions examined by the Court (see para 110 above).*"

Thames Water's submissions

1109. Thames Water submit that no such injunction should be ordered. They object to an injunction on a number of grounds.

1110. First, they say that there is no *prima facie* case of a continuing nuisance and the order is expressed not to come into force until the end of 2012. They say that this recognises that whilst major further work is being carried out it would be inappropriate to seek an immediate order. They refer to various projects: Project 59HF to cover and treat processes; Project 7H9G the East side PST/FST conversion and Project 5X8F, the West side expansion works. Thames Water submit that it would be inappropriate to make an order which seeks to predict and regulate a state of affairs some time into the future, not least because the impact of the West side expansion works can only be properly assessed when the works are completed. They say that, in particular, the court cannot be satisfied now that MTSW in 2013 and onwards is likely to cause odour amounting to a nuisance, unless restrained by such an order which is a critical finding required before such an injunction can be granted. They refer to Mr Peirson's acceptance that he could not give an opinion as to the position on odour emissions in 2013. They say that similar grounds invalidate any claim in respect of mosquitoes.

1111. Thames Water submit that, even if there otherwise prima facie reasons for making an order in the form sought by the Claimants, it would be wrong to do so on the facts of this case. They refer to the principles to be derived from Shelfer v City of London Electric Lighting Co [1895] 1 Ch 287as re-stated and explained by the CA in Watson v Croft [2009] 3 All ER 249 at [44] to [46] and [51], approving the following summary by Mummery LJ in Regan v Paul Properties Limited [2006] EWCA Civ 1391 at [36] as to the relevant principles to be derived from Shelfer as:

> *"(1) A claimant is prima facie entitled to an injunction against a person committing a wrongful act, such as continuing nuisance, which invades the claimant's legal right.*
> *(2) The wrongdoer is not entitled to ask the court to sanction his wrongdoing by purchasing the claimant's rights on payment of damages assessed by the court.*
> *(3) The court has jurisdiction to award damages instead of an injunction, even in cases of a continuing nuisance; but the jurisdiction does not mean that the court is "a tribunal for legalising wrongful acts" by a defendant, who is able and willing to pay damages: per Lindley LJ at pages 315 and 316.*
> *(4) The judicial discretion to award damages in lieu should pay attention to well settled principles and should not be exercised to deprive a claimant of his prima facie right "except under very exceptional circumstances." (per Lindley LJ at p 315 and316).*
> *(5) Although it is not possible to specify all the circumstances relevant to the exercise of the discretion or to lay down rules for its exercise, the judgments indicated that it was relevant to consider the following factors: whether the injury to the claimant's legal rights was small; whether the injury could be estimated in money; whether it could be adequately compensated by a small money payment; whether it would be oppressive to the defendant to grant an injunction; whether*

> *the claimant had shown that he only wanted money; whether the conduct of the claimant rendered it unjust to give him more than pecuniary relief; and whether there were any other circumstances which justified the refusal of an injunction: see AL Smith LJ at pages 322 and 323 and Lindley LJ at page 317."*

1112. Thames Water submit that, in addition to the reasons set out above, there are exceptional reasons why an injunction should not be granted in this case.

1113. First, Thames Water submit that they are under two critical statutory duties, not only under s.94(1)(b) WIA effectually to deal with the contents of sewers but also to accept all flows into their sewers under s.106 WIA. They are thus in an entirely different position from, say, the electricity company acting under statutory powers in Shelfer. Thames Water cannot do anything other than operate MSTW to treat all the flows which arise from its catchment. The effect of an injunction, if granted, inevitably would impinge upon the performance of their statutory duty. Thames Water therefore submit that this is a case which would justify refusal of an injunction because it would be oppressive to Thames Water and/or of the public interest weighing against the grant of such an injunction, and also because there is a powerful "other circumstance" which is to be set against the relatively modest damage which would be suffered in the absence of such an injunction.

1114. Thames Water submit that justiciability issues arise in response to this claim for an injunction. One possible response to the grant of an injunction would be Thames Water's decision to proceed to further capital works to avert any possibility of Thames Water being found to be in breach, which they assume is what the Claimants are seeking. If so, they submit that this is a very strong reason why such an injunction should not be granted because Thames Water's legal obligations under that order would then drive outputs accepted by Ofwat and such outputs drive the additional allowances made to Thames Water to comply with the requirements of such outputs. Thames Water submit that this driving of the process by such legal obligations is what the Marcic principle seeks to avoid, as shown by the mandatory order sought by Mr Marcic.

1115. Secondly, under the principle that "equity does nothing in vain", Thames Water submit that, given the existence of a binding s.106 planning agreement in very detailed terms enforceable by LBH, there is no need for a more vaguely and broadly worded injunction as sought by the claimants.

1116. Thirdly, under the principle that a party coming to equity must have "clean hands", Thames Water submit that delaying tactics by certain Claimants have postponed the start of the West side expansion works. Thames Water say that, but for those tactics, the west side expansion works would have been completed by the end of 2012 but this deadline is unlikely to be met. They refer to the following chronology, which I summarise:

(1) The planning application was originally submitted on 2 June 2008.

(2) On 5 December 2008 Mr Taylor on behalf of MRAG wrote to the relevant LBH committee asking them to defer consideration of the application until this Court had ruled.

(3) On 8 December 2008 the committee deferred the consideration, against the advice of its officers, who said that the application was acceptable, subject to a stringent s.106 notice.
(4) On 4 March 2009 the committee delegated approval of the application subject to the negotiation of a sufficient s.106 agreement
(5) On 8 June 2009 the committee confirmed its position, subject to a revised s.106 agreement.
(6) On 25 November 2009, the committee again confirmed their position
(7) On 17 December 2009, after a meeting of the Executive of the Council, three odour abatement notices were served by LBH on Thames Water.
(8) On 23 December 2009 the s.106 agreement was signed

1117. Thames Water say that the strategy of MRAG in conjunction with certain councillors on the committee was to delay the signing of the s.106 agreement until after the hearing of this case and pressurise officers within LBH to serve an immediate abatement notice. They say that litigant members of MRAG were instrumental in achieving delay in the s.106 agreement and hence in the extension works designed to increase the capacity of the works and improve the quality of the effluent into the River Thames. That, Thames Water submit, should disable the Claimants from obtaining an injunction.

1118. In any event, Thames Water submit that if any injunction would otherwise be granted with effect from the end of 2012, the proper order would be to suspend its operation for a reasonable time with liberty to Thames Water to apply for a further suspension in the event of circumstances rendering it necessary for such an application to be made.

1119. Finally, Thames Water refer to the original wording of the injunction "*to restrain the Defendant by itself, its servants or agents from causing or continuing a nuisance by way of odour or mosquito infestation to the Claimants herein after 31 December, 2012*". They say that, first, that formulation fails to recognise that Thames Water will be acting lawfully as long as it takes reasonable steps in running its business to try to avoid creating that nuisance and the proposed order would be depriving Thames Water of their defence of statutory authority.

1120. Secondly, Thames Water contend that any injunction requires considerable precision of wording, so as to enable Thames Water to know precisely what they can or cannot do from the date of the order. They refer, by comparison, with the terms of the s.106 planning agreement which they submit, provides a sensible structure.

Decision

1121. I have decided that an injunction is not appropriate in this case for the following reasons:

(1) I am not satisfied that, on my findings, there is a continuing nuisance caused by a breach of the Allen duty or that there will be when the order comes into force in at the end of 2012. Thames Water are taking steps to increase the capacity of Mogden STW and are carrying out work which may or may not be complete by the end of 2012.

(2) In any event, as the proposed order indicates, it would not come into effect until 31 December 2012 and by that date the plant at Mogden will have had further work carried out. It will therefore not be clear what the relevant nuisance would be which was prevented by the injunction.

(3) The exception in the proposed injunction for nuisances which are "*the inevitable consequence of the Works being operated without negligence*" introduces further uncertainty which makes breach difficult to ascertain and enforce.

(4) There could potentially be a conflict with the statutory scheme if and to the extent that compliance required Thames Water to carry out major capital works or projects.

(5) There is in existence the s.106 Agreement which, whilst not actionable by the Claimants, provides a mechanism for controlling the operations at Mogden STW.

1122. Rather, on the basis of the findings in this judgment, if by the end of 2012, there is still a breach of the Allen duty then it will be open to the Claimants to seek an appropriate order, in particular, if other methods of enforcement are ineffective.

Conclusion

1123. Accordingly, for the reasons set out above I find that Thames Water are liable to the Claimants for breach of duty in relation to the nuisance caused by odour at Mogden STW, the scope and extent of that liability being set out above. I also find that there has been a breach of rights under the HRA by way of breach of Article 8 of the Convention.

1124. In the circumstances, I award the Schedule A Claimants damages as set out in the attached appendix, together with special damages, as set out above. However, I am not satisfied that, in all the circumstances, an award of damages is necessary to give just satisfaction to the Schedule B Claimants. I do not grant an injunction.

Address/Claimant		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
133 Haliburton Road 1 Hilary Thomson 2 Ian Thomson	Rental/month Percentage Damages/year		£1400 1.25% £210	£1400 1.25% £210	£1400 1.25% £210	£1400 1.25% £210	£1400 2.5% £420	£1400 2.5% £420	£1400 1.25% £210	£1400 1.25% £210	£1400 0%	£1400 0%	£2100
95 Worton Road 6 Rachel Addis	Rental/month Percentage Damages/year		£1050 5% £630	£1050 5% £630	£1050 5% £630	£1050 5% £630	£1050 5% £630	£1050 3.75% £472.50	£1050 2.5% £315	£1050 1.25% £157.50	£1050 0%	£1050 0%	£4095
2 Windemere House 8 Sandra Weston	Rental/month Percentage Damages/year					£700 0%	£700 2.5% £210	£700 2.5% £210	£700 1.25% £105	£700 2.5% £210	£700 0%	£700 0%	£735
66 Weavers Close 9 Steve Taylor 10 Wendy Taylor	Rental/month Percentage Damages/year	£925 5% £462.50	£925 5% £555	£925 5% £555	£925 5% £555	£925 5% £555	£925 5% £555	£925 5% £555	£925 3.75% £416.25	£925 1.25% £138.75	£925 0%	£925 0%	£4347.50
34 Arnold Crescent 12 Susan Ford	Rental/month Percentage Damages/year		£1500 1.25% £225	£1500 1.25% £225	£1500 1.25% £225	£1500 1.25% £225	£1500 0%	£1500 1.25% £225	£1500 0%	£1500 0%	£1500 0%	£1500 0%	£1125
179 Whitton Dene 16 Charles Edwards 17 Judith Edwards	Rental/month Percentage Damages/year		£1300 1.25% £195	£1300 1.25% £195	£1300 1.25% £195	£1300 1.25% £195	£1300 0%	£1300 0%	£1300 0%	£1300 0%	£1300 0%	£1300 0%	£780
97 Mogden Lane 20 Phillipa Spurrell	Rental/month Percentage Damages/year		£1100 2.5% £330	£1100 2.5% £330	£1100 2.5% £330	£1100 2.5% £330	£1100 5.0% £660	£1100 3.75% £495	£1100 2.5% £330	£1100 2.5% £330	£1100 0%	£1100 0%	£3135
45 Elmer Gardens 23 Marc Foord 24 Sharon Foord	Rental/month Percentage Damages/year		£1350 1.25% £202.50	£1350 1.25% £202.50	£1350 1.25% £202.50	£1350 0%	£1350 0%	£1350 0%	£1350 0%	£1350 0%	£1350 0%	£1350 0%	£607.50
86 Summerwood Road 27 Rodney Bayne	Rental/month Percentage Damages/year		£900 1.25% £135	£900 1.25% £135	£900 1.25% £135	£900 1.25% £135	£900 2.5% £270	£900 2.5% £270	£900 1.25% £135				£1215
5 Worple Avenue 31 Paul Fisher 32 Shirley Fisher	Rental/month Percentage Damages/year		£1100 1.25% £165	£1100 1.25% £165	£1100 1.25% £165	£1100 1.25% £165	£1100 2.5% £330	£1100 2.5% £330	£1100 2.5% £330	£1100 2.5% £330	£1100 0%	£1100 0%	£1980

	Total												£20,120.00