

Thames River Catchment - A Status Appraisal

John N. Duder BE, MICE (retd.), FIPENZ

1. Introduction

In discussions on Thames Water's proposals for construction of the Thames Tideway Tunnel, attention has been focused on pollution of the Thames Tideway and measures to address the problems.

However the water quality of the tideway is a combination of inflows from the London tributaries and the upstream inflow at Teddington from the overall Thames River Basin catchment. Addressing the tideway problems should include analysis of the upper catchment inputs, drawing on available data on the status of waters, the measures being established and the prospects for improvements.

The purpose of this paper is to summarise water quality data available on line from the Draft Thames River Basin Management Plan, the consultative document published by the Environment Agency (EA) in 2015, giving a wealth of data on the health of the whole Thames catchment including all its tributaries.

2. Overview

Thames Water (TW) propose to construct a £4.5 billion tunnel under the tidal Thames to collect and store discharges and combined sewer overflows (CSO's) from tributaries of the tidal Thames. TW maintain that the Thames Tideway Tunnel (TTT) is the most cost effective and preferred method of cleaning up the tideway to meet the European Union's water framework directive (WFD) standards.

A wide range of alternative clean up methods has been promoted by well qualified scientists and engineers including Professors Chris Binnie, Colin Green and Richard Ashley, Lord Tony Berkeley and other specialists. Their submissions include drawing attention to water quality improvements from upgrades of the Mogden, Beckton and Crossness sewage treatment works (STW's) and the soon to be completed Lee River diversion tunnel. Also supported are integrated catchment management techniques in the tidal Thames catchments an approach endorsed in principle by the Institution of Civil Engineers publication 'The State of the Nation: Water 2012'.

This paper presents a summary of data from the consultation documentation published by EA in 2009/10 and updated in 2013/14, to demonstrate how much work has been done and is ongoing to improve the water quality in the whole catchment. That points to the prospect of achieving the aims of the TTT at comparable if not lesser cost and with wider benefits; simplistically a number of 'fences at the top of cliffs' rather than an expensive ambulance at the bottom of the catchment.

3. Summary of Environment Agency Documentation

The EA published an initial assessment of water quality in all Thames Basin rivers in 2009 and updated that information to 2013/14 (Ref. 1) in terms of the general status of each water body (Good, Moderate, Poor, Bad), summarised economic analyses of proposed improvements (benefits and costs) and concluded with a statement of EA's confidence in attaining improvements by 2021 (High, Medium or Low).

The results for each principal Thames Basin river are summarised in Table 1 attached, along with the main urban centres which will be the principal sources of two of the main causes of river pollution i.e. overflows from STW's and transport, the other two most common being diffuse rural run off and physical changes .

The reports on each river catchment also give considerable detail on observed sources of pollution and on the anticipated benefits and disbenefits on the ecosystem services affected by the proposed works in terms of water quality, society and the environment. Each operational catchment section concludes with a summary of the key mechanisms to deliver improvements by 2021, as summarised simply Yes/No in Table 2 attached, finishing with the EA's confidence in achieving the proposed long term objectives by 2021 (i.e. High, Medium or Low).

Tables 1 and 2 cover all the non-tidal Thames catchments from the Cotswolds and the Cherwell in the west to the Colne, Wey, Mole and Hogsmill further east. Also included is the Darent discharging into the tideway - refer to catchment plans in Appendix A.

The above noted documents were distributed by EA for public consultation in 2015, the results of which are awaited. It is noted that partnerships have been established with local NGO's/environmental groups, as listed in Table 1 attached, from the EA documentation.

Attached as Table 3 is a summary of the Thames Tideway/London catchments in terms similar to Tables 1 and 2.

4. Commentary on Tables 1, 2 and 3

4.1 Thames Basin Catchments (non-tidal) - refer to Figure 2 in Appendix A

a. Summary of Table 1

The following columns in Table 1 give an overview of the state of the basin's catchments mainly above Teddington:

- The status in 2009 and any changes by 2014 (most showing no significant changes i.e. no deterioration or improvement) of which about three quarters are either Poor or Bad.
- EA's percentage expectations for improvement to a Good status in the long term.
- EA assessment of proposed spending by 2021 totalling £1.864 billion and the expected benefits, noted to include some intangibles/non quantifiable benefits; virtually all cost benefit ratios are at least 1.0 with only two exceptions.
- Each operational catchment has an environmental partnership active or at least recently established (refer Table 2).
- The final column gives EA's confidence in the improvements being achieved towards 2021 – mostly Medium.

The main causes of pollution in each catchment are predominantly waste water from STW's along with discharges from urban centres and transport and rural diffuse sources of pollution. The attached diagram (Figure 12 in Appendix B) shows the observed causes of these problems to support the conclusions by others that either discharges or CSO's from the several

hundred STW's in the catchment would appear to be the prime source of pollution, see Section 5 below.

b. Mechanisms for Improvements by 2021, Table 2

Each operational catchment section in reference 2 typically contains a considerable amount of detail on pollution problems e.g. phosphates, nitrates and gives proposed measures to deal with them and concludes with a tabulation of the availability of some key mechanisms to deliver improvements by 2021 (as also in Table 1).

The headings in Table 2 are abbreviations of the following measures:

- Have measures been implemented (or are secured for 2014 – 15) that will deliver improvements that have not yet been reflected in classification results? e.g. Catchment Sensitive Farming, Catchment Restoration Fund Projects.
- Are there measures planned to deliver Protected Area objectives that will also contribute to improvements in water body status?
- Has this operational catchment been identified in water company draft business plans as an area for improvement?
- Has this operation catchment been identified as a priority for action under the new environmental land management schemes (NELMS)?
- Have the local catchment partnership identified measures they are likely to secure funding for, which will bring about improvement within the 2nd cycle?
- Are any additional improvement measures included in Environment Agency or other statutory plans?

4.2 London Management Catchments (tidal Thames) – refer Figure 3 in Appendix A

Table 3 gives information for the tidal catchments equivalent to the Thames Basin catchments in Tables 1 and 2 with the following specific comments on each column:

- Of the nine river catchments listed five had Poor status in 2009 and four Moderate with mostly no change but three recording some improvement by 2014. The two groups of aquifers both had poor status without change to 2014 i.e. no deterioration or improvement.
- EA's prediction of long term Good status has four of the seven expected to reach 100% chance of achieving that status.
- As with Table 1 the benefits and costs all give a B/C ratio of at least 1.0 with the total costs adding up to £360 million.
- The penultimate column comments on the mechanisms in place for the improvements by 2021, equivalent to Table 2 for the Basin catchments.
- All catchments have at least some mechanisms for improvements by 2021.
- Finally EA confidence for mechanisms for improvements towards 2021 are either High or Medium for the river catchments, but Low for the two aquifer groups and the tidal Thames.

In general it would appear from the above that the London management catchments (tidal tributaries) are in somewhat better shape than the overall Thames Basin catchments, pointing towards the potentially significant contribution to tidal pollution from the wider catchment above Teddington.

5. Additional Comment on Thames catchments upstream of Teddington

From the limited information available from 1990 studies it is understood (Alan Hooper and Roland Gilmore pers. com.) that:

- There were 67 sewage treatment works (STW) in the non-tidal Thames catchment with a population equivalent of 10,000 or more and a further 240 smaller STW's.
- A substantial proportion of the flow in the Thames came from sewage works; the estimated average flow from the 300+ STW's upstream of Teddington was 1.5 million cubic metres per day compared to an average flow over Teddington weir of about 4 million cubic metres per day i.e. 37%.
- Orthophosphate from STW's was 12 tons per day in 1991 and 7 tons per day in 1993. Agricultural load has been estimated variously as between 7 – 13% of the total.
- The largest inflow to the Tideway is from the upper Thames over the Teddington weir. Flows range from around 13 m³/sec to more than 63 m³/s in floods with an annual mean flow of about 45 m³/s.

Further comparative evaluation of the respective catchment yields would require fuller data on hydrology, pollutant sources and downstream measurement, as currently being sought in the Tideway, to give perspective on what can be expected from progressive improvements in the overall catchment.

6. Pollution from Teddington Weir Inflows

It is understood that a primary concern relating to the Thames Tideway and hence the rationale for the TTT is the issue of CSO's and discharges from STW's not meeting specific requirements in the London area. As noted above, similar CSO's and associated pollution can be expected from the overall Thames catchment.

By reference to Thames River Basin District Data.xlsx (Reference 3), a comparison has been made between qualitative chemical data from larger lower Thames and London area water bodies, specifically the status of ammonia pH dissolved oxygen and phosphate as expected in 2015.

- Lower Thames, water bodies >40km²: Colne, Hogsmill, Mole, Wey and the Thames River from Reading to Teddington.
- London Area, water bodies >30km²: Beverley Brook, Brent, Colne, Lower Lee, Ravensbourne and Wandle.

In summary, all such larger water bodies in both areas rank Good or High for pH and with only two exceptions for ammonia, and most catchments rank Good or High for dissolved oxygen.

However in terms of phosphate, over 90% of the London River Basin District water bodies (by inference prior to upgrade of major STW's), rank Bad or Poor and likewise 45% of the lower Thames RBD water bodies. These figures point to differences in the Overall Classification Status of the water bodies, with the Lower Thames rankings spread fairly evenly between Bad/Poor, Moderate and Good/High, whereas 78% of London water bodies ranked Bad/Poor, 22% Moderate and none Good/High, presumably not allowing for Mogden, Beckton and Crossness STW upgrades.

It can be concluded that while attention is being focussed on the water bodies and large populations contributing directly to the Tideway including STW upgrades, the significant phosphate pollution, by inference from STW discharges and storm spills arriving at Teddington, should be taken into account in tackling the Tideway's problems.

7. Preliminary Conclusions

1. Addressing Thames Tideway pollution has focused on the London catchments without comparable attention to pollution from the wider Basin catchment at Teddington.
2. There is a considerable body of data by the Environment Agency on water quality and potential improvements throughout the whole Thames catchment.
3. Addressing those improvements would be in general accord with integrated water catchment management, an approach supported in essence by the Institution of Civil Engineers (Ref. 2).
4. The proposed improvements will benefit both individual catchments and the Thames River downstream to Teddington and on through the tideway, indicating a potential alternative approach to Thames Water's Tideway Tunnel (TTT).
5. The total envisaged costs amount to around £1.860 billion above Teddington and some £360 million for the tideway catchments compared with £4.5 billion for the TTT. (Note: The two indicative amounts are summed from Tables 1 and 3)
6. Aside from the relative costs, the benefits from catchment works would be widely spread with a range of social, economic and environmental flow-on effects.
7. Implementation would require input not just from partnerships but from territorial agencies and the water industry throughout the Thames River Basin.

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John N. Duder

BE (Civil), AMICE 1963 – 2013, FIPENZ, CP Eng., ONZM, JP

Fifty five years experience in water resource engineering specialising in river works, coastal engineering and hydroelectric projects.

- 1960 – 1973 - Sir Alexander Gibb & Partners, London, including site responsibilities in Nigeria, Pakistan (Mangla and Tarbela Dams) and New Zealand (Tongariro Power Development).
- 1973 – 2004 – Tonkin & Taylor Ltd, New Zealand as Senior Engineer, Associate and Director including site work in South East Asia and the southern Pacific.
- 2004 – 2015 – Independent Consultant on hydroelectric projects, river works and dam inspections.

Resident in London for total of five years, including familiarity with the tidal Thames from Hammersmith to Medway.

References:

1. The Draft Thames River Basin Management Plan 2015

https://consult.environment-agency.gov.uk/portal/ho/wfd/draft_plans/consult?pointId=s1405418030714#section-s1405418030714

2. Institution of Civil Engineers, The State of the Nation: Water 2012

3. Thames River Basin District Data: xlsx

Attachments:

Table 1: Thames River Basin – Summary of Status as at 2013/14

Table 2: Thames River Basin, Availability of Key Mechanisms to Deliver Improvements by 2021

Table 3: The London Management Catchment, A Summary of Status & Key Mechanisms as at 2013.

Appendix A, The Catchments:

Figure 2: The Management Catchments in the Thames River Basin District

Figure 3: The London Management Catchment

Appendix B, Reasons for Not Achieving 'Good' Status:

Figure 12: The Thames River Basin

Figure 5: The London Catchment

Note: Figures 2, 3, 5 & 12 are taken from Reference 1.

Table 1: Sheet 1 of 2

Thames River Basin – Summary of Status at 2013/14

River & Operational Catchments	Urban Centres	General Status in 2009 & Changes by 2014	Percentage of Good in Long Term %	Economics (£ million) Proposed spending Benefit Cost B/C ratio	Major Causes of Pollution	EA Confidence in Improvements Towards 2021
CHERWELL Cherwell/Oxford Canal Oxon Ray Banbury Jurassic gwb Upper Thames gravels	Banbury, Kidlington, New Hinksey Bicester, Oxford Stow-in-the-Wold, Cheltenham (Shallow)	Generally poor Bad (n/c) Good/poor Poor (n/c)	40 27	31.3 29.9 1.02 10.9 10.8 1.0 110.3 76.4 1.44 5.4 7.5 0.72	Invariably <u>waste</u>	Medium Medium Low
COLNE	Hemel Hempstead Watford, Slough	Poor/bad		769 427 1.8	<u>water</u>	High
COTSWOLDS AND THE VALE River Ock Upper Thames Windrush	Abbingdon, Didcot Oxford, Wantage Cirencester, Swindon Carterton, Witney	Poor (n/c) Bad (n/c) Bad (n/c)	15 57 59	8.9 58.0 0.2 37.1 36.7 1.04 32.0 28.9 1.13	<u>discharge</u> , urban	Low Medium Medium
DARENT The Cray and Shuttle Darent	Aperfield, Orpington, Bexley Oxford, Seven Oaks, Dartford	Moderate (n/c) Moderate (n/c) Generally poor	66 100	14.3 7.8 1.8 15.0 0.5 29.0	transport and	High High
EVENLODE Surface water only excl. groundwater	Morton-in-Marsh, Chipping Norton, Charleberry, Cosington, Stow-on-the-Wold, Woodstock	Good/moderate (n/c) Poor (n/c)	41 55	30.6 29.1 1.05 249.7 125.6 1.99	diffuse rural, some physical	Medium Medium
KENNET Kennet Groundwater body	Newbury, Thatcham, Reading, Marlborough, Hungerford	Good/moderate (n/c) Poor (n/c)	41 55	30.6 29.1 1.05 249.7 125.6 1.99	changes etc.	Medium Medium
LODDON Loddon plus Blackwater Basingstoke aquifer	Basingstoke, Farnborough, Wokingham.	Poor (n/c) Poor (n/c)	12	69.0 66.5 1.1 249.7 125.6 1.99		Medium Medium

Table 1: Sheet 2 of 2

Thames River Basin – Summary of Status at 2013/14

River & Operational Catchments	Urban Centres	General Status in 2009 & Changes by 2014	Percentage of Good in Long Term %	Economics (£ million) Proposed spending Benefit Cost B/C ratio	Major Causes of Pollution	EA Confidence in Improvements Towards 2021
LOWER THAMES The River & Local Tributaries	Staines, Windsor, Bracknell, Maidenhead Slough to Teddington	Poor/moderate (most n/c)	7?	59.5 29.8 2.0		Medium
Maidenhead Chalk gw	Walton on Thames, Sunbury	Poor (n/c)		405.4 127.6 3.18		Medium
MOLE Upper Mole	Crawley, Horley, Red Hill Leatherhead, Gatwick	Moderate, dropped in 2013	90	60.0 59.4 1.01		Medium
Lower Mole and Rytte	Reigate, Walton on Thames, Dorking	Poor (n/c)	75	55.3 37.7 1.47		Medium
Reigate Dorking gw(2)	Dorking, Red Hill, Leatherhead	Poor (n/c)	100	Not completed		Low
RODING, BEAM AND INGREBOURNE	Chipping Ongia, Loughton, Brentwood	Poor (n/c)	69	196.7 150.7 1.3		Medium
THAME AND SOUTH CHILTERN Upper Thame	Aylesbury, Thame, Henley, Wallingford	Poor to bad (n/c)		44.7 38.4 1.20		Medium
Pang, Thames, Wye	High Wycombe, Marlow, Reading	Poor (n/c)		43.1 32.8 1.45		Medium
Chiltern scarp gw	Wallingford, Wendover, Tring	Poor (n/c)		249.7 125.6 1.99		Medium
UPPER LEE	Luton, Stevenage, Harlow	Moderate/poor (n/c)	96	714.0 368.0 1.90		High
WEY The River/Navigation	Alton, Farnham, Godalming, Guildford, Woking, Weybridge	Moderate (n/c)	38	70.9 71.0 1.0		Medium
Guildford Chalk gw	Hogs Back - Clondon			5.3 0.5 10.5		Medium

Table 2: Sheet 1 of 2

Availability of Key Mechanisms to Deliver Improvements by 2021

Catchment and Rivers	Measures Not Reflected in Classification Results?	Protected Area Objectives Contributing to Water Body Status?	Improvements Identified in Draft Business Plans?	Priority Under NELMS?	Partnership Funding Within Second Cycle?	Improvements in EA or Other Plans?	EA Confidence in Improvements by 2021
CHERWELL							
Cherwell	Y	Y	Y	Y	No	Y	M
Oxon Ray	No	Y	Y	Y	Y	Y	M
Ground Water Bodies (gwb)	Y	No	Y	Y	N/A	No	Low
COLNE							
COLNE	Y	Y	Y	Y	Y	Y	H
COTSWOLDS AND THE VALE							
River Ock	No	Y	Y	Y	Y	No	Low
Upper Thames	Y	Y	Y	Y	Y	Y	M
Windrush	Y	Y	Y	Y	No	No	M
The Vale gwb	Y	Y	Y	Y	No	No	M
DARENT							
The Cray and Shuttle	No	Y	Y	No	Y	Y	H
Darent	Y	-	No	No	Y	Y	H
EVENLODE							
Surface water only excl. groundwater	Y	Y	Y	Y	Y	Y	M
KENNET							
Kennet	Y	Y	Y	Y	Y	Y	M
Groundwater body	Y	Y	Y	Y	Y	Y	M
LODDON							
Loddon plus Blackwater	Y	No	Y	Y	Y	Y	M
Basingstoke aquifer	No	Y	Y	Y	-	Y	M

Table 3. THE LONDON MANAGEMENT CATCHMENT – A SUMMARY OF STATUS AT 2013

River/Aquifer	2009 (Change?) General Status of Water Environment	Some Key Features	% Water Body in Long Term "Good" Status	£ million Present Value: Benefit Cost B/C	Comments	Mechanisms in Place for Improvements by 2021?	Confidence in Mechanisms for Improvements by 2021
1. Crane	Moderate (n/c)	Heathrow, Mogden STW	100%	88 45 1.96	Part of W. London green chain. ? Mogden STW benefit not included?	Yes, except PA plans	
2. Brent	Moderate (n/c)	Reservoir, Wembley, GU canal	29%	97 61 1.60		Yes, except PA plans	High (all 5 bodies good l/f)
3. Lower Lee	Poor (very) (n/c)	Olympic Park, industrial	90%	180 186 1.0	? Lee Tunnel included?	Yes, except NELMS	Medium
4. Hogsmill	Moderate (n/c)	Residential and open space	50%	12.2 11.9 1.02	Above Teddington	No, except catchment improves & LP	Medium
5. Beverley Brook	Moderate (some improvement)	Highly urbanised	100%	9.8 9.0 1.1		No, except NELMS	Medium
6. Wandle	Poor (some improvement)	"Heavily" modified but significant "bluegreen"	50%	19 18 1.0	Some 'good' prospects	No except Water Co, LP and EA plans	Medium
7. Ravensbourne	Poor (some improvement)	Urbanised 2 aquifers for water supply	100%	32.5 29.75 1.1	Good prospects longer term	No, except LP and EA plans	High
8. Marsh Dykes	Moderate (n/c)	Residential, industrial	100%	3.2 3.1 1.01		No, except EA and Water Co plans	Medium
9. Greenwich, 3 Aquifers	Poor (n/c) (saline intrusion)	Chalk, tertiary geology	-	- - -	Thames river from city/Bermondsey to Erith	No, except catch. Improve and EA plans	Low
10. Epsom/North Downs Aquifers	Poor (n/c) (links with Wandle)	Chalk drinking water protected areas	-	- - -		Yes, except PA	Low
11. Thames Tidal	Poor (some) improvement	Teddington to the sea	61% incl. one "high"	0.02	Beckton STW? Not "good" by 2021. No mention of TTT.	Yes, except catch. improve & NELMS	Low

(n/c) = no change by 2013; NELMS = New Environment Land Management Schemes; LP = Local Partnership; PA = Protected Areas

Figure 2 shows the location of the London management catchment within the Thames River Basin District.

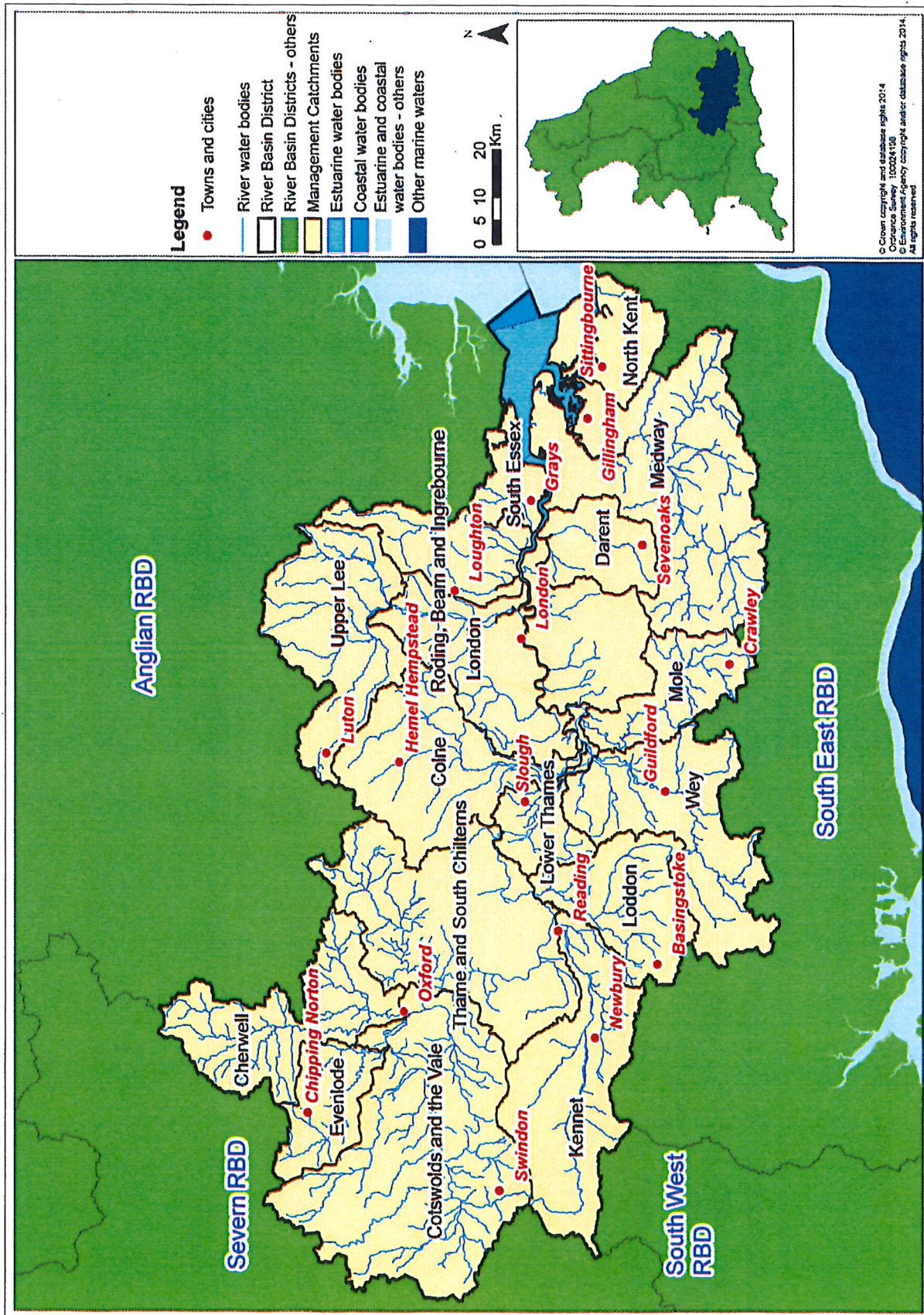


Figure 2 - Map of the Thames river basin district and the management catchments within it

FIG. 3 The London Management Catchment



Figure 3 - Map of the London management catchment and the operational catchments within it. The blank white area includes the lost rivers in central London and other areas. These are considered to be part of the London management catchment, but also belong to the Tidal Thames operational catchment, which is covered by a separate catchment summary.

Figure 12: The issues preventing waters reaching good status and the sectors identified as contributing to the impact on the Thames River Basin

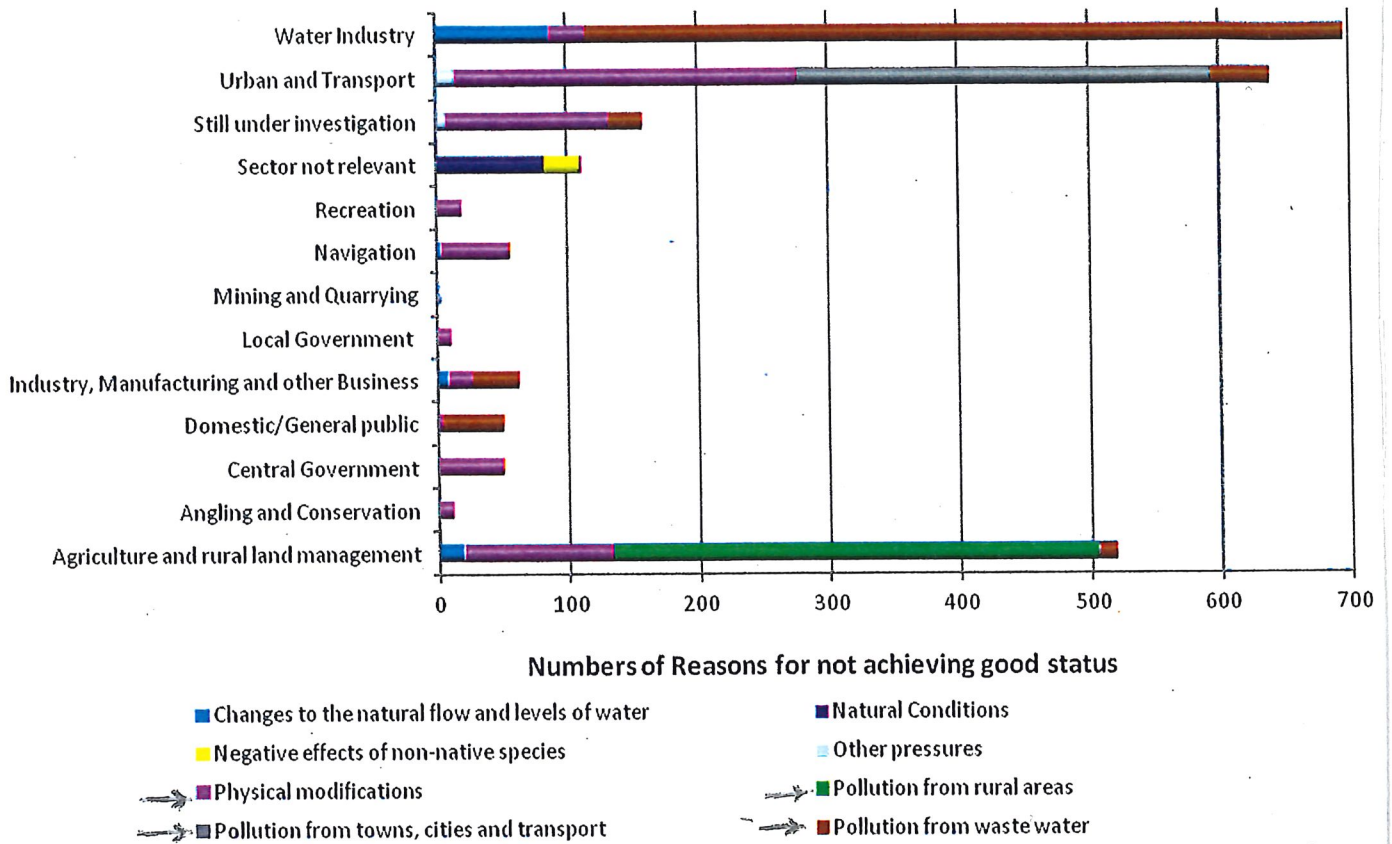


FIG. 12.

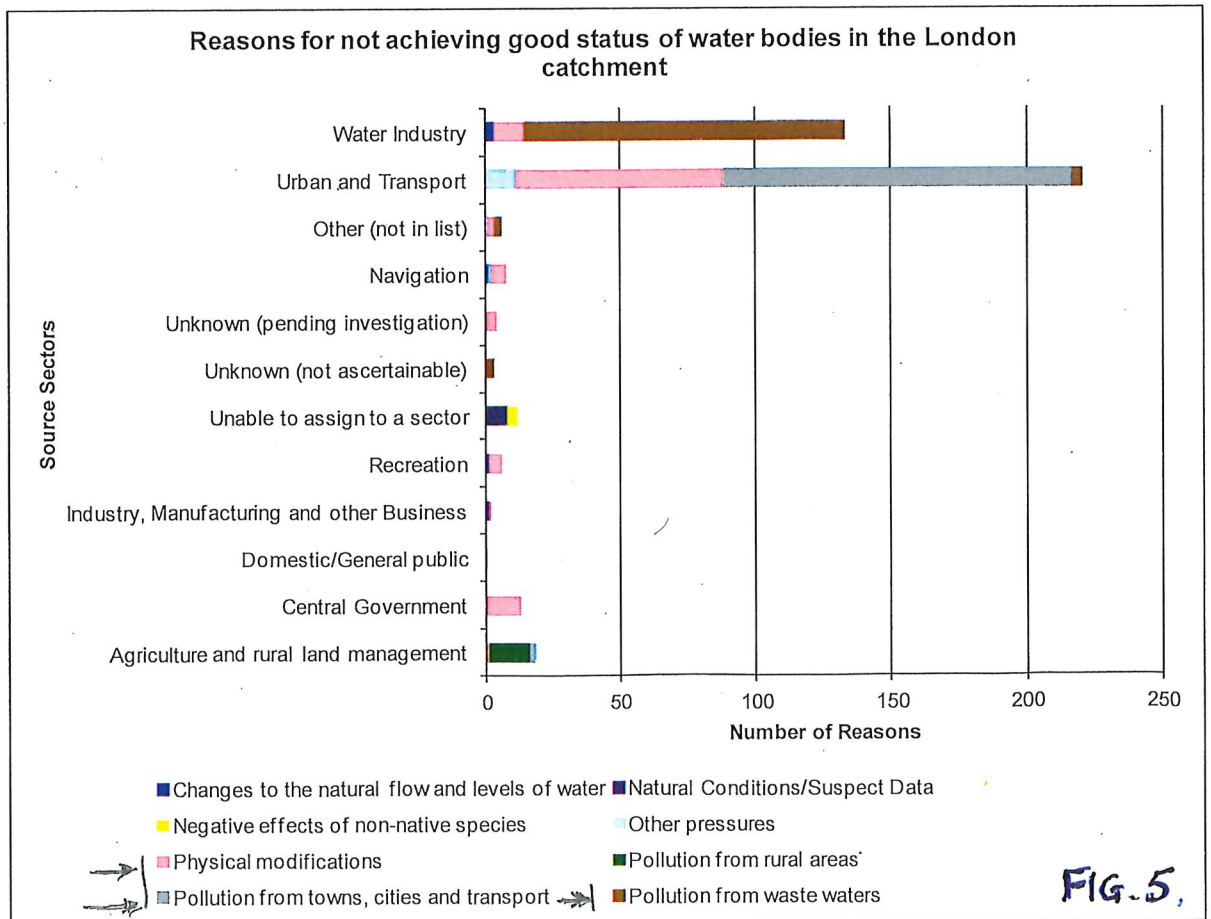


FIG. 5.

Figure 5 - Chart showing the reasons for not achieving good status of water bodies in the London management catchment by type and source sector