PART 2A OF THE ENVIRONMENTAL PROTECTION ACT 1990

ST LEONARD'S COURT

DECISION DOCUMENT

PART 1

Environment Agency

July 2019

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PART 2

Figures

Figures A-E are referred to in the main text; all Figures apart from D are referred to in Appendix 2

Glossary of terms and acronyms used in the Decision

Affinity	Affinity Water (previously Three Valleys Water) or any successor(s) to the water undertaking
Agency	Environment Agency
Agency's First Notice	Remediation Notice drafted by the Environment Agency and served on 8th November 2005
AGP	*The Environment Agency's Approach to Groundwater Protection*, February 2018 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/692989/Environment-Agency-approach-to-groundwater-protection.pdf
AOD	Above Ordnance Datum
AP	Appropriate Person (being Crest and Redland)
Beechgrove	Beechgrove (Sandridge) Management Limited
BS EN 5667	BS EN ISO 5667 - Water quality. Sampling https://doi.org/10.3403/BSENISO5667
CD	Consultation Document December 2018
CDE	Catchment Data Explorer
Chemfix	Chemfix International Limited, advisers to Crest
CLR11	Model Procedures for the Management of Land Contamination. Contaminated Land Report 11 Environment Agency 2004 https://www.gov.uk/guidance/land-contamination-risk-management (CLR11 has been updated and is entitled Land contamination: risk management LCRM. Link as above)
Crest	Crest Nicholson Residential Limited
DD	Decision Document
Draft Decision	Consultation Document December 2018

DWI	Drinking Water Inspectorate
EA	Environment Act 1995
EA enf & sa policy	Environment Agency enforcement and sanctions policy. January 2019 https://www.gov.uk/government/publications/environment-agency-enforcement-and-sanctions-policy/environment-agency-enforcement-and-sanctions-policy
EPA	Environmental Protection Act 1990
First Decision	Decision Document for Agency's First Notice
First Notice	Remediation Notice dated 22nd July 2009 and issued by the Secretary of State for the Environment Food and Rural Affairs
FW Berk	FW Berk & Co (company registration number 34597 and now known as Redland Minerals Limited)
GAC	Granular Activated Carbon, an adsorption water treatment method
Groundwater Appraisal	Groundwater Appraisal Guidance: Tool for estimating the costs and benefits of groundwater measures Revised Version - September 2018. In Economic appraisal tools and guidance, available through the link: https://www.gov.uk/government/publications/river-basin-management-plans-accessing-data-and-information-guide
Hydraulic containment	Hydraulic containment is used to control the movement of contaminated groundwater, preventing the continued expansion of the contaminated zone
IR	Report by The Planning Inspectorate (reference made to individual paragraphs of that report) to the Secretary of State for Environment, Food and Rural Affairs dated 23rd November 2007 following the Public Inquiry
LCRM	Land contamination: risk management. To replace CLR11 https://www.gov.uk/guidance/land-contamination-risk-management

NERA 2002	The Economics Of Balancing Supply & Demand (EBSD) Main Report https://ukwir.org/reports/02-WR-27-3/67205/The-Economics-of-Balancing-Supply--Demand-EBSD-Main-Report UKWIR Reference :- 02/WR/27/3 Published Date :- 31/10/2002 ISBN :- 1-84057-272-8
NNR wells	Northern New River wells
OG Investigation	*Factual report of a site investigation undertaken in April and May 2014 at Orchard Garage, Sandridge* (Date: September 2014. Reference: LT/SAN/CJC/2708/01OGF). This report can be found in Appendix A of the Revised Methodology submitted as part of Action D3, referred to here as Report D3b
Part 2A	Part 2A Environmental Protection Act 1990
Plume	Unless otherwise clear from the context, refers to the bromate plume
Plumes	The bromate and bromide plumes
Public Inquiry	Public Inquiry into appeals by Redland Minerals Limited and Crest Nicholson Residential plc against the Contaminated Land Remediation Notice served by the Environment Agency April/May 2007
Raw Water	Water abstracted from the environment, prior to treatment for use
RBMP	Thames river basin district River Basin Management Plan: 2015 https://www.gov.uk/government/collections/river-basin-management-plans-2015#thames-river-basin-district-rbmp:-2015
RCS	Required Concentration Standards of bromate less than or equal to 5 µg/l and bromide less than or equal to 500 µg/l (see First Notice, Action I (b)(iii) and IR 846-848)
Redland	Redland Minerals Limited
Regulation 4	Regulation 4 of the Water Industry (Prescribed Conditions) Regulations 1999 (as amended)
Regulations 2006	Contaminated Land (England) Regulations 2006 (SI 2006 No. 1380)

Regulations 2012	Contaminated Land (England) (Amendment) Regulations 2012 (SI 2012 No. 263)
Report A	*Report on the Loads of Bromate and Bromide Held in the Strata Beneath the Site at St Leonard's Court, Sandridge,* Report dated 4th June 2010 to comply with Action A in the First Notice
Report B	*Report on the Mass Flux in Groundwater of Bromate and Bromide from the Site at St Leonard's Court, Sandridge*, Report dated 4th June 2010 to comply with Action B in the First Notice
Report C	*Review of the Scope for Modelling of the Plume of Bromate and Bromide in Groundwater Associated with St Leonard's Court, Sandridge,* Report dated 4th August 2010 to comply with Action C in the First Notice
Report D	*Report on the Assessment of Potentially Suitable Locations for the Abstraction and Disposal of Groundwater Contaminated with Bromate and Bromide*, Report dated 4th June 2010 to comply with Actions D, D1 and D2 in the First Notice
Report D3a	*Proposal for a Pumping Trial at an Existing Abstraction Borehole Down Hydraulic Gradient of St Leonard's Court, Sandridge,* Report dated 4th July 2010 to comply with Action D3 in the First Notice
Report D3b	*Methodology for a Pumping Trial at Orchard Garage, Sandridge,* Report dated March 2018 to comply with Action D3 in the First Notice
Report D3c	*Pumping Trial Undertaken in March 2018 at Orchard Garage, Sandridge,* Report dated June 2018 to comply with Action D3 in the First Notice
Report E	*Report on the Review of any Additional Actions which Could Break the Pollutant Linkage or Mitigate the Effects with Respect to Groundwater Contaminated with Bromate and Bromide,* Report dated 4th August 2010 to comply with Action E in the First Notice
Report F1	*Consideration of the Options and the Best Practicable Technique for the Remediation of the Bromate and Bromide Contamination in Groundwater,* Report dated July 2018 to comply with Action F1 in the First Notice

RS	The APs' suggested scheme for voluntary remediation which accompanied their consultation response
SADC	St Albans City and District Council
SCL	Significant contaminant linkage (previously significant pollutant linkage)
Second Notice	The notice the subject of this Decision
SLCourt	St Leonard's Court (previously referred to as SLC)
SOCG	Statement of Common Ground – 19th March 2007
SoS	The Secretary of State for the Environment Food and Rural Affairs
SoS Letter	Decision letter issued by the Secretary of State regarding the First Notice (reference made to individual paragraphs of that letter) – 22nd July 2009
SPL	Significant pollutant linkage (now significant contaminant linkage)
TVW	Three Valleys Water
TWA	Thames Water Authority
TWUL	Thames Water Utilities Limited or any successor(s) to the water undertaking
Remediation Statement	Remediation Statement as defined in s.78H(7)EPA
WA	Water Act 2003
Water Company(ies)	Affinity Water and/or Thames Water Utilities Ltd or any successor(s) to their respective water undertakings
Water Regulations	Water Supply (Water Quality) Regulations 2016 (SI 2016 No. 614)
WFD	Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (O.J. No. L327, 22.12.2000, p. 1)
WFD Regulations	Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (SI 2017 No. 407)

WHO	World Health Organisation
Woolwich	Woolwich Homes (1987) Limited
µg/l	Micrograms per litre which equates to parts per billion or mg/m3, in a liquid sample
2012 Guidance	Environment Protection Act 1990: Part 2A, Contaminated Land Statutory Guidance (Defra April 2012)

A. Introduction

1. This Decision Document (DD) sets out the decision of the Environment Agency (the Agency) to issue a second remediation notice (Second Notice) in respect of land at St Leonards' Court (SLCourt) and as to the contents of that notice. This follows a Consultation Draft (CD) dated December 2018.

2. Part 1 contains the main text, tables and appendices. All figures referred to are in Part 2 of the document. As several of the consultation responses made reference to the CD paragraphs, the main text retains the paragraph numbers used in the CD. Where further paragraphs have been added, they have been labelled using sequential lettering. However there is no implied interconnection between paragraphs which start with the same number. Similarly, an inserted section has a number following the letter of the section heading.

2a. The Second Notice is served with this DD.

3. In making the Decision, the Agency has taken into consideration a number of documents including:

- Relevant Legislation:
  - Part 2A Environmental Protection Act 1990 (Part 2A)
  - Contaminated Land (England) Regulations 2006 (SI 2006 No. 1380) (Regulations 2006)
  - Contaminated Land (England) (Amendment) Regulations 2012 (SI 2012 No. 263) (Regulations 2012)
- Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance. April 2012 (2012 Guidance)
- Environment Agency enforcement and sanctions policy. January 2019
- Remediation Notice drafted by the Environment Agency and served on (8th November 2005) (Agency's First Notice)
- Decision Document for Agency's First Notice (First Decision)
- Statement of Common Ground dated 19th March 2007 prepared for the public inquiry of April/May 2007 into appeals by Redland Minerals Limited (Redland) and Crest Nicholson Residential Ltd (Crest) against the Agency's First Notice (Public Inquiry)
- Report by The Planning Inspectorate dated 23rd November 2007 following the Public Inquiry (IR)
- Decision of the Secretary of State dated 22nd July 2009 (SoS Letter)
- Judgments of Mr Justice Sales, neutral citation numbers [2010] EWHC 561 (Admin) and [2010] EWHC 913 (Admin) dated 3rd and 4th February 2010
- Results of completed Assessment Actions from the Remediation Notice dated 22nd July 2009 and issued by the Secretary of State for the Environment Food and Rural Affairs (First Notice)
- All documents that formed the bundles at the Public Inquiry
- Other documents referred to in this document

- Thames river basin district River Basin Management Plan: 2015 (RBMP)
- *The Environment Agency's Approach to Groundwater Protection*, February 2018 (AGP)

4. This DD supports the Second Notice served on those identified as Appropriate Persons (APs - Crest and Redland).

A.1 Consultation

4a. The Agency has considered the consultation responses received and has made appropriate amendments to the Second Notice. The amendments are explained with reference to the relevant responses within this document. Appendix 1 lists consultation responses with references, descriptions and dates. These documents are available on request, appropriately redacted. Where there has been no comment made in response to a specific point, this should not be taken as agreement.

5. Responses from the statutory consultees were received by the required date of 31st March 2019, a little over 3 months from the issue date of the Draft Decision covering letter. Other responses were made within 2 months of the date the consultation first appeared on the Agency's online consultation hub: https://consult.environment-agency.gov.uk/hnl/land-contamination-at-st-leonards-court-sandridge For the avoidance of doubt, statutory consultees are those falling within s.78H(1)(a)-(c)EPA.

Responses from non-statutory consultees

5a. We received six responses to the online consultation: two from local government; one from national government; and three from community groups and members of the public. The responses have been appropriately redacted and can be found on line at: https://consult.environment-agency.gov.uk/hnl/land-contamination-at-st-leonards-court-sandridge/supporting_documents/20190502%20Nonstat%20response%20summary%20FINAL.pdf
These have been considered and the Agency's response is summarised in Appendix 3.

5b. Public Health England, Welwyn Hatfield Borough Council and Hertfordshire County Council's Public Health service (following discussion with the County Council's Environment Department in its capacity as Flood Authority and Minerals Planning Authority) have all responded and support the Agency's proposals.

5c. Hertfordshire County Council recommends the addition of a further borehole for monitoring purposes. We agree that a monitoring point near to the scavenging location would generally be good practice. However, in this case, we consider it would be of little value. Further detail is given at paragraph 146a.

5d. Appendix 3 contains details of the responses with the Agency's comments.

Responses from statutory consultees

5e. We have received consultation responses from the APs, Affinity, TWUL, Hertfordshire County Council Rural Estates, St Albans City and District Council (SADC), Welwyn and Hatfield District Council, Cemex and D'Arblay Investments. Apart from the APs, these organisations are statutory consultees by virtue of being affected landowners. They raise no objection to the continued use of their land as in the First Notice. However, D'Arblay do raise concerns about both longer term, and greater, use of their land.

5f. The APs' and Water Companies' responses raise detailed points which are referred to in the relevant parts of this DD.

5g. SADC were responsible for determining SLCourt as contaminated land prior to the designation as a "Special Site" (EPA 1990, Part IIA).

B. Background

6. The background to this matter will be familiar to the parties who have been involved and was set out in detail before the Public Inquiry. Further detail can be found in the IR. The key points are repeated here in Sections C to J for ease of reference.

7. Bromate and bromide contamination in the Chalk aquifer in the vicinity of Hatfield, Hertfordshire, originate from the site of a former chemical works in Sandridge. FW Berk & Co (company registration number 34597 and now known as Redland Minerals Limited) manufactured bromine-based chemicals, including sodium and potassium bromate, at SLCourt from approximately 1955 until about 1980. Raw materials including bromine, red and yellow phosphorus and caustic soda were processed into various products including ceta-stearyl bromide and other organobromine compounds, hydrobromic acid, sodium and potassium bromate and zinc bromide. Waste known to have been produced at SLCourt includes aqueous bromide, caustic aqueous bromide, solid bromide, bromochloropropane, empty tins and contaminated rubbish.

8. It is probably during this period that the chemicals entered the soil.

9. Chemical manufacture ceased in or around 1982. Following its purchase by Crest in 1983 SLCourt was redeveloped in 1987 as high-density housing.

10. The history of ownership of F W Berk and Company which owned SLCourt is shown below:
    - prior to 3rd January 1966 FW Berk & Company Limited,
    - from 3rd January 1966 Berk Limited,
    - from 29th March 1977 Steetley Chemicals Limited,
    - from 31st December 1986 Steetley Berk Limited,
    - from 20th April 1988 Steetley Minerals Limited and

- from 1st November 1993 Redland Minerals Limited through the acquisition by Redland of Steetley Minerals on 27th March 1992.

11. Contamination of the groundwater at Bishops Rise pumping station was first discovered by Three Valleys Water (TVW) in late May 2000 when it was testing groundwater in preparation for implementation of a new limit for bromate in drinking water under the now repealed Water Supply (Water Quality) Regulations 2000 (SI 2000 No. 3184).

12. Bromide had been found in the groundwater down gradient of SLCourt by Thames Water Authority (TWA) in 1983 prior to Crest's purchase of SLCourt and in Jersey Farm lagoon in 1978.

13. Since May 2000, TVW's groundwater abstraction at Bishops Rise, Hatfield, has not been used for public supply and restrictions have been placed on the use of three private supplies (Nashes Farm, Cap's Cottage and the Home Office PSDB establishment) due to the level of bromate in the groundwater. Bromide levels at Nashes Farm are also known to have reached levels in excess of 3,000 μg/l which is well over thirty times background Chalk groundwater concentrations for the area. At a second TVW groundwater abstraction at Essendon concentrations of bromate are restricting its use such that the water abstracted has to be treated and blended with other uncontaminated water utilising a purpose built water main to TVW's North Mymms Water Treatment Works. In addition, public supply boreholes operated by Thames Water Utilities Limited (TWUL) in the Middle Lee Valley between Ware and Turnford, known collectively as the Northern New River wells (NNR wells), some 20km from SLCourt, have also shown elevated concentrations of bromate restricting their use in the public supply of water.

14. The location of SLCourt and the surrounding area is shown in Figure A. The bromate plume extends eastwards from SLCourt.

C. Ownership of SLCourt

15. Crest exchanged on the purchase of the major part of SLCourt from Redland on 1st September 1983 and completed the purchase on 22nd September 1983. Crest purchased the remainder of SLCourt from the Salvation Army on 18th November 1983.

16. In November 1986 Crest transferred SLCourt to Woolwich Homes (1987) Limited (Woolwich).

17. Beechgrove acquired the entire freehold of SLCourt from Woolwich on 18th January 1989 and is still the freeholder. Beechgrove's shareholders are the leaseholders of the individual properties at SLCourt.

D. Planning history of SLCourt

18. On 1st February 1984 planning permission was granted to Crest by St Albans City and District Council (SADC) for 30 houses plus outline permission for office accommodation.

19. Crest did not proceed with the development permitted in February 1984.

20. An application for planning permission for 70 houses was made by Crest in December 1985 but withdrawn during 1986.

21. Crest applied for planning permission for 66 houses, the present development, on 25th March 1986 and SADC granted permission on 25th July 1986.

22. At the time of the planning applications the regulatory authority for water quality issues was TWA.

E. Development of SLCourt

23. Crest demolished Steetley's buildings and hardstandings in March-April 1984. The redevelopment into the buildings now present at SLCourt was completed sometime between November 1986 and October 1987. The site was open to infiltration for more than two years, allowing the contaminants to be flushed to greater depth.

F. Determination of SLCourt as contaminated land

24. On the 20th June 2002, SADC notified the Agency that SLCourt had been identified by them as contaminated land under section 78B(1) EPA.

G. Designation of SLCourt as a special site

25. The Agency assumed responsibility as the regulator for SLCourt on 8th August 2002 when it became a special site under s. 78C(1) EPA.

H. Consultation under s. 78H(1) EPA before service of the Agency's First Notice

26. There were two rounds of consultation before the Agency's First Notice was served.

I. The Agency's First Notice

27. The Notice was served on Redland and Crest on 8th November 2005.

J. Appeals against the Agency's First Notice

28. Redland and Crest lodged their appeals against the Agency's First Notice under cover of letters dated 29th November 2005 and 1st December 2005, respectively. The appeals were recovered for determination by the Secretary of State (SoS) on 4th April 2007. The appeal was heard at a public inquiry held over 13 days between 16th April and 8th May 2007. The SoS issued a decision on 22nd July 2009. This upheld the actions of the Remediation Notice that the Agency recommended to the Inspector at the appeal hearing, but varying the division of responsibility between Crest and Redland.

29. Crest and Redland challenged the SoS decision in the High Court by way of judicial review. Their applications were refused at a hearing in the High Court – see judgments of Mr Justice Sales, neutral citation numbers [2010] EWHC 561 (Admin) and [2010] EWHC 913 (Admin) dated 3rd and 4th February 2010, respectively.

K. Compliance with the First Notice

30. Crest and Redland have completed eleven of the twelve actions in the First Notice, being Assessment Actions A, B, C, D, D1, D2, D3, E, F1, G and H. A copy of the First Notice is provided at Appendix 3 of this document. The twelfth, Action I, is scavenge pumping from Affinity's borehole at Bishop's Rise, near Hatfield and is ongoing. The scavenge pumping is required until 22nd July 2019, that is ten years from the date of the First Notice.

31. Remediation Action I was developed during the Public Inquiry. The Inspector concluded there was an urgent need for interim action to protect public water supply abstraction points in the lower part of the contaminant plume, downstream of Bishop's Rise. The purpose of the Assessment Actions was to identify a longer term remediation which would also remediate the upper part of the two plumes. Groundwater in this part of the plumes was used by the Bishop's Rise abstraction itself and for private supplies until the water was found to be unsuitable for use.

32. The report for Action F1 was submitted on 16th July 2018 and is discussed further in Section O.

33. The APs began monitoring under Actions G and H in May 2010 and continue to monitor voluntarily, on a quarterly basis, despite Actions G and H expiring in 2015.

33a. The Agency acknowledges that completion of the actions in the First Notice took the APs a long time, especially the pumping trial. The problems included negotiating with landowners for access to land upon which the pumping trial took place, negotiating access

to the sewer to discharge the pumped water and the potential pollution of the River Colne into which the receiving sewage treatment works would discharge the effluent from the pumping trial. The APs refer to these difficulties in their response to the consultation at Annex A_Crest paragraphs 67, 71, 74 and 130 and Annex B_Crest paragraphs 11, 12, 34, 82, 85 and 88.

33b. The actions in the Second Notice may involve some of the same difficulties. The APs are dependent on the third parties to engage with them. However, the Agency does not consider that this will prevent compliance with those actions. The Second Notice builds on the steps taken pursuant to the First Notice and there is a greater level of knowledge about the issues involved. Separate consultation has been carried out on the draft Second Notice, and all of the relevant landowners have been consulted (including those whose consent may be required under section 78G(2) EPA – schedule 6 of the Second Notice). If difficulties are encountered, the Notice allows for this provision in the Act by which third party landowners must facilitate remediation by granting such rights in relation to any relevant land or waters to enable an appropriate person to comply with a remediation notice.

L. Changes to the regulations and guidance since 2009

34. There have been changes to regulations and guidance since the First Notice was made. This document takes account of these changes.

35. The current versions of the Contaminated Land Regulations are:

- Contaminated Land (England) Regulations 2006 (SI 2006 No. 1380) and the
- Contaminated Land (England) (Amendment) Regulations 2012 (SI 2012 No. 263).

36. The 2012 Guidance has replaced the previous statutory guidance, Annex 3 of Defra Circular 01/2006.

36a. The Model Procedures for the Management of Land Contamination (Contaminated Land Report 11, “CLR11”) has been the principal technical framework used for managing the risks from land contamination since it was published in 2004. The Environment Agency published an update to CLR11 online in June 2019, the Land Contamination: Risk Management (“LCRM”). The scope, purpose and framework remains the same. It is not intended to impact upon any ongoing or planned land contamination projects that were produced under the framework introduced by CLR11. The Agency has also invited feedback on the technical content and structure of the LCRM for a period of 6 months. For the purposes of the decision on the Second Remediation Notice, the Agency has continued to refer to CLR11. Any changes that the LCRM may require can be taken into account in due course.

M. Does SLCourt still fall within the definition of Contaminated Land and Special Site?

37. In paragraph 4.4 of the First Decision the Agency considered these questions and it is appropriate to do so again, especially in the light of the amendment to s.78A(2)(a)EPA by s.86(2)(a)Water Act 2003 (WA) adding the requirement that pollution of controlled waters must be significant. In relation to SLCourt where the significant contaminant linkage (SCL), previously significant pollutant linkage (SPL), relies on the pollution of groundwater the two matters are:

    Is contamination still entering groundwater?

    Is there significant pollution of controlled waters?

    The Agency answers these questions respectively in M.1 and M.2 below.

M.1 Is contamination still entering groundwater?

38. At paragraph IR 825 the Inspector concluded that:

    IR825 ...Whilst bromide and bromate are already present in these groundwaters, in dissolved form, there is no suggestion that entry has ceased or that further entry is unlikely.

    Direct evidence that this is still the case would require new boreholes to be drilled at SLCourt. The number required would be difficult to predict and apart from the cost, the amount of disruption caused to residents would be disproportionate. However, there is sufficient indirect evidence.

39. Monitoring carried out under the First Notice shows that groundwater concentrations beneath SLCourt and down hydraulic gradient remain high. Overall, the average concentrations of bromate and bromide covering five years (Jan 2013 – Dec 2017) for each sample location in Actions G, and H of the First Notice show concentrations of bromate at SLCourt in excess of 2000 µg/l, and those of bromide up to 256,260 µg/l (see Figure B and Table B for a summary of locations with mean concentrations).

40. There is no indication of an overall decline in concentrations over time.

41. Groundwater concentrations remain high in spite of the removal of substantial quantities of bromate and bromide by the scavenge pumping required by Action I. The totals of bromate and bromide removed by scavenge pumping up to the end of 2017 were 5038kg and 12,137kg respectively – see Affinity's report, *Aquifer Remediation at Hatfield for Bromate Licence Report 2017*. This report, or a redacted version can be provided, on request.

42. The *Factual report of a site investigation undertaken in April and May 2014 at Orchard Garage, Sandridge,* September 2014 (OG Investigation) shows fissure water concentrations higher than pore water concentrations in borehole 1. Based on this location at least, equilibrium has not been reached between the flowing groundwater and water held within the Chalk blocks and therefore there is no indication that concentration is broadly decreasing within the plumes. The APs say this view is not justified (Annex A_Crest, paragraph 42, also Annexes B_Crest and C_Crest) but the Agency does not accept the APs' comments. More detail is given in Appendix 2, *Secondary Sources?* (paragraphs 23 to 30).

43. In conclusion, the Agency is satisfied that bromate and bromide are continuing to enter groundwater from SLCourt.

M.2 Is there significant pollution of controlled waters?

44. Section 78A(2) EPA as amended states:

> *"Contaminated land" is any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that–*
> *(a) significant harm is being caused or there is a significant possibility of such harm being caused; or*
> *(b) significant pollution of controlled waters is being caused or there is a significant possibility of such pollution being caused;*

Section 78A(5) states:

> (*a) what harm [or pollution of controlled waters] is to be regarded as "significant",*
> *(b) whether the possibility of significant harm [or of significant pollution of controlled waters] being caused is "significant",*
> *(c) . . . shall be determined in accordance with guidance issued for the purpose by the Secretary of State*

45. Paragraph 4.38 (b) of the 2012 Guidance includes:

> *4.38 The following types of pollution should be considered to constitute significant pollution of controlled waters: . . .*
> *. . .(b) Inputs resulting in deterioration of the quality of water abstracted, or intended to be used in the future, for human consumption such that additional treatment would be required to enable that use.*

46. Paragraph 4.41 of the 2012 Guidance adds that:

> *4.41 In deciding whether significant pollution of controlled waters is being caused, the local authority should consider that this test is only met where*

it is satisfied that the substances in question are continuing to enter controlled waters; or that they have already entered the waters and are likely to do so again in such a manner that past and likely future entry in effect constitutes ongoing pollution. For these purposes, the local authority should:

(a) Regard substances as having entered controlled waters where they are dissolved or suspended in those waters, or (if they are immiscible with water) they have direct contact with those waters on or beneath the surface of the water.

(b) Take the term "continuing to enter" to mean any measurable entry of the substance(s) into controlled waters additional to any which has already occurred.

(c) Take the term "likely to do so again" to mean more likely than not to occur again.

47. The pollution of groundwater by SLCourt is significant. Simply as an indication of the seriousness of the pollution, the plume maps in Report F1, Figures 4A and 5A show recent concentrations in groundwater (2016-2017) that exceed the Required Concentration Standards (RCS).

48. By way of an example, at Bishop's Rise, Hatfield, the 5 year average concentrations (2013-2017) are 312.35 µg/l bromate and 741.62 µg/l bromide. These concentrations are well in excess of the RCS as well as the drinking water standard for bromate of 10 µg/l stated in Water Supply (Water Quality) Regulations 2016 (SI 2016 No. 614) (Water Regulations).

49. Affected water supply companies and private water supply abstractors have had to take action to combat the pollution.

50. Firstly, Affinity's public drinking water abstraction at Bishop's Rise has been taken out of supply and Affinity has installed and operates a new public water supply abstraction at Nomansland (Figure C), north of Sandridge away from the contamination. High concentrations of bromate have affected the use of public supply boreholes at Essendon. Affinity blends water from its Essendon source to make it suitable for public water supply. Affinity mention other indirect effects on their ability to supply water (Annex B_Affinity, paragraphs 8.3 to 8.11 and Affinity_Further, paragraph 15.4).

50a. Affinity suggest at Affinity_Further, paragraph 15.4 wording to Action11.A (b)(i)(1) of the Second Notice that would mean the APs pay costs directly or indirectly attributable to the treatment of bromate contaminated water. Paragraph 4 of Schedule 2 Regulations 2006 lists the grounds of compensation. Further, under paragraphs 3(1) and 6(3) of Schedule 2 Regulations 2006 a third party must claim compensation from the APs and has the right to refer such a claim to the Upper Tribunal. Therefore, it is for a third party to make a claim from the APs within the terms of Schedule 2 Regulations 2006 and the wording suggested

by Affinity in the Second Notice is not appropriate. The entitlement for compensation is a matter for the third party and the APs.

51. Secondly, groundwater abstracted from TWUL's NNR wells in the Lee Valley, some 20 km from SLCourt, must be treated and blended to achieve potable water quality standards. The Agency understands from TWUL that an upgrade to the Hornsey Water Treatment Works (Figure C) has been necessary in order to improve treatment for bromate.

52. Thirdly, the groundwater pollution resulted in three private drinking water abstractions being restricted in their use at Nashes Farm, Cap's Cottage and Home Office PSDB establishment. These restrictions are still in place.

N. The need for subsequent Remediation Notices

53. The 2012 Guidance recognises the potential need for phased remediation notices:

> *6.11 In some cases, it may not be possible or reasonable for a single remediation notice to specify all the remediation actions which might eventually be needed. In such cases, the enforcing authority should specify in the notice the remediation action(s) which it considers to be appropriate at the time, and further remediation notices may need to be issued later regarding further phases of action.*
>
> *6.12 If a phased approach is taken to remediation, before serving any further remediation notice, the enforcing authority should be satisfied that previous action has not already achieved the remediation of the land (i.e. to a standard to which remediation can reasonably be required, having regard to the advice below), and that further action is still necessary to achieve the remediation of the land in question.*

54. The introductory paragraphs of Schedules 2 and 4 of the First Notice both state:

> *The final Remedial Treatment Actions which will enable the land and controlled waters to be effectively remediated, to the required standards, cannot yet be identified. This is because specific Assessment Actions are needed to characterise in detail the SPLs and to collect data to evaluate the likely effectiveness of Remedial Treatment Actions. Schedule 2 identifies a series of Assessment Actions that will enable Remedial Treatment Actions to be specified in one or more subsequent Remediation Notices. However pollution of controlled waters is continuing. Schedule 2 therefore also includes an interim Remedial Treatment Action which is required to be implemented in a timescale and in a form set out in Schedule 2.*

55. The Inspector's Report and the SoS letter are clear in their intention that the First Notice will inform the actions required by one or more future remediation notices. The SoS stated:

21. The secretary of State agrees with the Inspector that it is not appropriate to specify the concentration-levels of bromide and bromate to which the aquifer should be remediate within the remediation notice. Consideration of this point is found at IR 846-848 and 858-860. These concentrations will need to be established when the long-term method of remediating St Leonard's Court is specified in subsequent remediation notice(s). Delaying this decision will allow the relevance of the information gathered in response to this first remediation notice to be considered in the decision making process.

56. The Agency is not satisfied the previous actions have fully remediated the groundwater pollution. Further work is necessary which includes interim scavenge pumping. The APs agree with this in their consultation response. (Annex A_ Crest, paragraph 56).

56a. As explained in more detail in paragraphs 31 and 57, the Bishop's Rise scavenge pumping is an urgent action. This remains the case. Further, it has become apparent that it is not just an interim action but it is also part of the long term solution as explained in paragraph 67 below.

56b. The Agency disagrees with the APs' narrow interpretation of the First Notice. The APs' comment on paragraph 31 of the CD at Annex A_Crest is that:

> *The objective of the current RN is to control the concentrations of bromate and bromide at the Relevant Abstraction Points (RAP) (Action I). The RN does not require remediation of the whole aquifer, but rather the achievement of specified standards at the identified points of abstraction.*

56c. The Agency also disagrees with the comments made by the APs at paragraph 7.3 of Annex B_Affinity. Paragraph 7.3 reproduces paragraph 31 of the CD and the APs comment on this paragraph in Annex B_Affinity is as follows:

> *Based on the wording of the current Remediation Notice the APs do not agree with the statement that the purpose of the Assessment Actions is to identify a longer term remediation solution which would also remediate the upper part of the two plumes. Continuation of Remedial Treatment Action I in the current Remediation Notice is contingent on concentrations of bromate and bromide recorded at Relevant Abstraction Points which comprise public water supply abstractions only and subject to an overall time limit of 10 years or such shorter period agreed with the EA. The requirement that the upper part of the plume (by which the APs assume Affinity mean the part of the plume proximal to SLCourt) is not specified in the Notice.*

The SoS refers to the objective of the remediation:

> *20. The Secretary of State agrees with the Inspector, at IR845, that the "suitable for use" approach to contaminated land should extend to water polluted by contaminated land as well as the land itself. This is a sensible interpretation of the statutory guidance. The Secretary of State therefore agrees that the objective of the remediation of the St Leonard's Court contamination should be to allow the aquifer to be used once more for potable supply of safe drinking water.*

Clearly the Assessment Actions required in the upper part of the plumes were designed to lead to remediation of the aquifer in a subsequent remediation notice or voluntary Remediation Statement - see paragraph 55 of this document. Whether the APs' reference to "*the Notice"* refers to the First or Second, the reason no remediation is specified is that further assessment actions were/are required before a remedial action can be identified. The Second Notice requires further assessment of the means to break the SCL in accordance with the Agency's Part 2A statutory duty and in line with paragraph 6.17 of the 2012 Guidance. The results of the assessment actions will also assist in establishing a reasonable level of remediation for subsequent notices or a voluntary Remediation Statement.

57. Action I of the First Notice, to scavenge pump from Hatfield, will expire in July 2019. The Agency is keen to ensure that remediation continues to keep bromate and bromide concentrations down at Essendon and the NNR wells. TWUL mention at A.3 of their response:

> *With the NNR Wells continuing to experience bromate concentrations well above the drinking water standard and the RCS set by the RN, and pumping significant mass of bromate into the Lee Valley water supply system, there is a clear need for continuation of contaminant remediation.*

In their response the APs say that the concentration of bromate in the drinking water supply is managed so that it meets the drinking water standard. However, this is not the point since the costs and risks should be borne by the APs as polluters, not by TWUL and Affinity (see section 8 of Annex B_Affinity). Further, the management of the supply does nothing to break the SCL to protect and remediate the aquifer. The SoS recognises the importance of this scavenge pumping and that the cost should be borne by the polluter:

> *24. As set out in paragraph 19 above, the pollution of the aquifer by contamination from St Leonard's Court is serious and ongoing. The extent and impact of the pollution is currently being limited by the actions of the Water Companies in undertaking scavenge pumping at Bishops Rise. If this scavenge pumping were not taking place, the Secretary of State is satisfied that the imminent danger of serious pollution would warrant urgent intervention.*

25. The Secretary of State supports the Inspector's conclusion that scavenge pumping at Bishops Rise is the best practicable technique currently available for the urgent remediation of St Leonard's Court (IR861 – 881). Inclusion of this action in the remediation notice would enable the ongoing costs to be borne by the polluters rather than by the and their customers as is currently the case. This urgent remediation should continue until a longer term solution is implemented. To accommodate the very slight possibility that the urgent action alone may successfully remediate the contamination, the Secretary of State agrees with the Inspector's recommendation (IR878-879) that scavenge pumping should cease if concentrations of bromate are reduced to 5 micrograms per litre at various specified monitoring points. The figure of 5 micrograms per litre of bromate may well prove to be more protective than the figure eventually arrived at for the remediation of the aquifer but the Secretary of State believes that is appropriate for these purposes.

57a. In their consultation response, the APs state in Annex A_ Crest, paragraph 57:

The Secretary of State is acknowledging that the current target set out in the RN is probably over protective.

He does not. At paragraph 25 the SoS says:

The figure of 5 micrograms per litre of bromate may well prove to be more protective than the figure eventually arrived at for the remediation of the aquifer . . .

"may well prove" is not the same as "probably". This is an interpretation by the APs of the SoS' words and the Agency does not agree with this interpretation.

58. When the Inspector recommended limiting the duration of Action I to a maximum of 10 years, it was in the expectation that the best practicable remedial technique would be understood by that time. The Inspector's report states:

IR877 Subject to the proviso that the obligation to fund these scavenging arrangements should cease, once long term remediation measures are in place or a reasonable level of remediation has been demonstrated, I believe that the notice should be modified to incorporate this as an interim requirement. However, given the uncertainties over progress that will be achieved towards remediation, I also consider it necessary to place a time limit on this requirement. The EA's suggestion that funding should continue for no longer than 10 years seems reasonable. By that time, the prospect of remediation will be better understood and those liable should have the opportunity to challenge a requirement for this scavenging to continue.

59. The Inspector and the SoS could not have foreseen the significant delays to the pumping trial required by Assessment Action D3 as a result of site-specific technical, operational and logistical matters, primarily associated with the disposal of contaminated groundwater. Importantly, Action D3 does not specify the location for the pumping trial, instead it begins:

> *At any existing abstraction boreholes identified under action D above and where the owner gives their consent, carry out a three-day pumping trial…*

60. The APs selected Orchard Garage as their preferred location for the pumping trial. The significant delays in resolving matters specific to a pumping trial at this site have delayed determining the best practicable technique identified under Assessment Action F1. Report F1 was received on 16th July 2018.

O. The Consideration of the Remediation Options (Report F1)

61. The First Notice required the APs to submit a report which considered the Remediation Options (Assessment Action F1). Report F1 was submitted to the Agency on 16th July 2018. Assessment Action F1 required the APs, using the information gained from the earlier Assessment Actions (namely D, Dl, D2, D3 and E of the First Notice), to assess the practicality, effectiveness and durability of each option and to evaluate which of the options amounted to the best practicable technique.

62. The Agency does not agree with all the conclusions that have been drawn in Report F1. Whilst outside the formal process, the Agency's comments were first aired at the BTWG meeting of 9 October 2018 where there was opportunity for open discussion between the APs, the Water Companies and the Agency. The key points of agreement and disagreement arise under five headings: most cost-effective options, contaminant migration, remediation options, treatment options and duration of remediation. A more detailed review of the Report F1 is provided in Appendix 2 with further explanation and full references not included here. Dealing with each issue in turn:

O.1 Most cost-effective option

63. The evaluation by the APs of the options under Assessment Action F1 was intended to include a comparison of the cost benefit analyses for each option (see First Notice F1(a)(ii)). The Report F1 that has been submitted only proposes one option, the continuation of scavenge pumping at Bishop's Rise and does not therefore include any comparative cost benefit analysis. The Agency does not accept that this is the only possible option and considers that further information is required to follow this through. The Second Notice therefore includes Assessment Actions to allow other options to be assessed.

63a. The APs' consultation response (Annex A_ Crest paragraph 63) acknowledges that in Report F1 they had not allocated costs explicitly to specific remediation options. They only

compared qualitative assessments of the likely cost of individual options and combinations of options.

63b. The Agency welcomes the additional work now carried out. The APs have compared the cost of scavenge pumping at Orchard Garage with that at Bishop's Rise in paragraphs 65-68, Annex C_Crest of their response to the Consultation Document. The results show a cost of £1,125 per kg of bromate removed from Bishop's Rise and compare this with an estimated cost of £5,080 to £5,780 per kg for bromate removal at Orchard Garage.

63c. However, this is a cost effectiveness analysis, not a cost benefit analysis. The benefits are different and therefore it is not a direct comparison. The APs do not consider the environmental benefits of the options, just how much it costs to remove bromate. Orchard Garage scavenge pumping would remove contamination from higher up the plume. Bishop's Rise removes contaminant but its main purpose is to reduce the contaminants moving down-gradient towards the current water supplies at the NNR wells and Essendon.

63d. The Agency acknowledges that there may be some ambiguity in the term cost benefit and it can be used to mean either cost effectiveness or cost benefit. Cost effectiveness analysis compares the relative costs and outcomes of different options and therefore enables an informed decision to be made as to the best option. Cost benefit analysis, on the other hand, provides a full assessment of the cost of the remediation option versus the environmental benefits. With respect to the SLCourt pollution plumes, the principal benefit is the volume of affected groundwater remediated.

63e. The Agency expects both meanings to be considered in line with the Agency's groundwater guidance entitled: Groundwater Appraisal Guidance: Tool for estimating the costs and benefits of groundwater measures Revised Version - September 2018 and associated documents (Groundwater Appraisal). This can be accessed in Economic appraisal tools and guidance through the link below:
https://www.gov.uk/government/publications/river-basin-management-plans-accessing-data-and-information-guide

Once the APs have carried out these appraisals, an objective assessment can be made.

63f. One of the relevant factors that needs to be taken into account is the value of the water that has been affected. The bromate and bromide plumes are within an area of serious water stress, as defined by *Environment Agency and Natural Resources Wales (2013) Water stressed areas – final classification.*
https://www.gov.uk/government/publications/water-stressed-areas-2013-classification.
This designation is for the purposes of Regulation 4 of the Water Industry (Prescribed Conditions) Regulations 1999 (as amended) (Regulation 4) but the classification document notes that it "has the potential to be applied to purposes other than metering."

63g. The Groundwater Appraisal guidance provides values for a cubic metre of water for impacts on fresh water (public water supply abstraction) in an area of serious water stress. The low (£0.84 per m^3) and high (£1.94 per m^3) values support sensitivity analysis, whilst the central value of £1.21 per m^3 should be used to help calculate the main result. These values are

based on AISC (average incremental social cost) values from the 2018 draft water company water resource management plans and have been calculated using the approach in the Economics of Balancing Supply and Demand (EBSD) Main Report https://ukwir.org/reports/02-WR-27-3/67205/The-Economics-of-Balancing-Supply--Demand-EBSD-Main-Report (NERA, 2002).

O.2 The evidence for contaminant migration

64. It is accepted that the situation is complex, and groundwater monitoring results are difficult to interpret with confidence (see Appendix 2 for the details). These results will require further analysis as additional information is collected. For instance: isolated peaks for a number of contaminants as well as bromate and bromide do occur at Essendon; Orchard Garage has shown concentrations which appear to be lower than those both up and down gradient; and NNR wells contaminant concentration relationship to groundwater level and Bishop's Rise abstraction rate is controlled by many factors. Above all, the source appears to continue to feed significant concentrations into the plume.

65. The Agency does not consider that sufficient evidence has been provided for the conclusions in Report F1. A conceptual model was discussed at the Public Inquiry and the APs have subsequently refined this in accordance with Model Procedures for the Management of Land Contamination. Contaminated Land Report 11 Environment Agency 2004 (CLR11) https://www.gov.uk/guidance/land-contamination-risk-management through assessment actions, including Report F1.

65a. Information on groundwater flow direction and change over time due to seasonal or other factors based on the monitoring data was not included. Groundwater contour maps are normally seen as fundamental to a conceptual understanding but the only indication of groundwater flow direction in Report F1 is from the contaminant plume maps that have been produced for bromate and bromide (Figures 4 and 5). The time lag in contaminant movement within the aquifer means that the plumes are likely to show a representative but averaged, pattern and any variations demonstrated by the more rapid response of groundwater levels could be masked.

65b. In their response to the consultation the APs (paragraph 65, Annex A_Crest) have confirmed that groundwater flow directions do not appear to vary seasonally or with changes in groundwater levels. The Agency agrees but many other uncertainties remain.

65c. The APs have helpfully provided considerable additional information in their consultation response as to why the concentration changes within the plume are not the result of exceptionally high groundwater levels in 2000/2001. However, there is insufficient additional information provided to support their conceptual model and their suggested location of the centre of the contaminant mass.

66. Therefore although a plausible model, based on the evidence that is currently available the Agency does not accept the suggestion in Report F1 that there has been a decreasing trend in the concentrations of the relevant contaminants in the upper part of the plume

accompanied by a persistent increasing trend in the lower part, consistent with a migrating plume. Although there are fluctuations, concentrations are, in fact, remarkably stable over the longer term. The model could be largely that of a spreading plume rather than a migrating one. Concentrations in the lower part of the plume are, for example, likely to be influenced by the recent reduction in abstraction rate at Bishop's Rise. The Agency does not believe there is sufficient evidence for the long term trends as the APs suggest. Further, if the steep concentration trends seen at SLCourt in the early 2000s, are back extrapolated to earlier times they would indicate extremely high concentrations between the early 1980s and the re-commencement of monitoring in the early 2000s (see further details at paragraphs 34-35 in Appendix 2).

67. Although the Agency does not concur with the conclusions reached under the Annex C_Crest summary section headed paragraphs 65-68, following consideration of the factual evidence in the APs' consultation response, the Agency's position is that scavenge pumping at Bishop's Rise is required as part of long term remediation. This factual evidence is based on the APs' calculations which show that more bromate has been removed from Bishop's Rise than at any other location (see Annex C_Crest, paragraphs 55 and 62). Not only does the scavenging provide a degree of hydraulic containment which may be difficult to achieve elsewhere but the Bishop's Rise pumping also removes significant quantities of contaminant. The hydraulic containment achieved can also protect the aquifer and abstractions downgradient. Up gradient there is potential to remove small quantities of water containing high concentrations of contaminant in areas where additional hydraulic containment may not be possible, or even necessarily required. Contaminants removed will clearly not migrate down gradient in the groundwater.

67a. Whilst the Agency's view is that there is insufficient evidence for the APs' current conceptual model, this does not prevent assessment actions for remediation to break the SCLs from proceeding. Indeed, the assessment actions themselves are likely to improve the conceptual understanding. TWUL refer to this in that they suggest not only using data and information gathered during the First Notice, but also that gathered during the proposed assessment and remedial actions of the Second Notice, especially data gathered from the proposed 12 month scavenge pumping trial(s) (Annex A_Thames, paragraph C.2). The Agency acknowledges that the APs included details of their conceptual model in Report F1 but for clarity we have added a specific requirement to the Report F1 update action, action 8a(iii).

67b. Both Water Companies suggest that a further assessment action is required to improve conceptualisation. Affinity refer specifically to an improved understanding of potential stratification in the Chalk aquifer and the effect on movement of the bromate plume (Annex B_Affinity, paragraph 3.5a and 9.5):

> *3.5a There is not enough understanding of the hydrogeology of the area and, as a result, how the plume is likely to move. Further work needs to be undertaken to understand the potential stratification in the chalk aquifer and the likely movement of the bromate plume through the different strata*

in order to either confirm the current conceptual understanding or revise it. This action should be undertaken in parallel to the assessments proposed by the Agency and these assessments should be tested against the new hydrogeological conceptualisation as it is understood.

9.5 We consider that the Agency should incorporate an additional Assessment Action in the Second Notice requiring the APs to undertake further research on the hydrogeological conceptualisation of the area. The purpose of this additional action would be to improve the common understanding of the contaminant transport and the potential stratification of the aquifer and develop a more robust conceptual model that could be used to inform future actions. The current mapping does not consider any potential stratification of the plume, and without such knowledge, it will not be possible to develop the Best Practicable Technique for remediation. This action could be undertaken in parallel to the other actions in the Second Notice with the findings being used to test the actions identified through the remaining actions in the Second Notice. Failure to do this could result in unnecessary actions being undertaken and/or effective actions not being identified.

The APs mention at paragraph 16.3 of Annex B_Affinity that since the BTWG meeting on 9 October 2018 some geophysical logging information has been provided to the APs for review in relation to water company abstraction boreholes at Nomansland, Bishop's Rise, Essendon and Middlefield Road. Based on this information the APs consider that robust correlation of stratigraphy based on the gamma logs is not practicable. The Agency has similarly attempted to correlate lithological variations between existing boreholes without success. There are insufficient details of the strata encountered. To require a new set of boreholes to be drilled would be expensive and may provide little additional information.

67c. The Agency agrees with the APs' comment on paragraph C.2 (Annex A_Thames) that an additional action specifically to refine the conceptual model would be costly and time consuming. The Agency's view is that it would be academically satisfying to have a better understanding of the hydrogeological processes at work within the plume but this is not essential and therefore it would be an unreasonable requirement.

O.3 Remediation options

68. It is acknowledged that there were delays in setting up the abstraction trial at Orchard Garage, but - even assuming that these sort of delays may occur elsewhere as well - such delays are not a valid reason to exclude pumping at several abstraction points in the long term.

69. The possible remediation options were identified in the *Report on the Review of any Additional Actions which Could Break the Pollutant Linkage or Mitigate the Effects with*

Respect to Groundwater Contaminated with Bromate and Bromide, dated 4th August 2010 (Report E). This is the report on Assessment Action E and no other reasonable options have emerged since then. There is a useful summary of the options available in Table 5 of Report F1, where they have been coded as red, amber and green options. The amber and green options merit further consideration. The Agency agrees that those shown in red cannot be considered to be the best practicable techniques, and do not merit further consideration.

70. It is clear that the continued abstraction at the Bishop's Rise site (referred to as option RB1) is a feasible option. Scavenge pumping at the borehole for use (referred to as option RC2) is also a potential option which merits further assessment. Although not specified in Table 5, elsewhere in Report F1 the use is described as use for public supply. This pumping could be done at Bishop's Rise and/or at other potential scavenging sites. Options RB1 and RC2 are essentially the same type of remediation option, in that they aim to break the SCL or to mitigate the effects on groundwater quality. The difference between them is in the treatment proposed (considered in O.4 below), which have very different outcomes and benefits.

71. The Agency notes that Report F1 does not use a consistent description of remediation option RB1. Table 3 of the Report F1 reviews the options appraisal included in Assessment Action E, and uses a wider definition for RB1 than the one used in Table 5. It is important that the consideration of RB1 is not restricted to the location at Bishop's Rise, and that any further assessment must include a mechanism to explore using alternative locations as well. The Agency considers that the RB1 option must allow for abstraction of water from the pathway at one or more locations down gradient of SLCourt itself.

72. The SCL in terms of the sources, pathways and receptors is described in Schedule 3 of the First Notice. It describes the receptor as *Controlled waters: Groundwater contained in, or in hydraulic continuity with the Chalk aquifer*. It is important when considering a list of receptors which includes groundwater that it includes consideration as a resource "*intended to be used in the future*" (as described in the 2012 Guidance, paragraph 4.38(b)), and not just the groundwater which issues to springs and provides the baseflow to watercourses. The wording used in Table 5 of Report F1 is incorrect where it refers to the treatment of the abstracted water (at the point of abstraction or use) as modifying the behaviour of a receptor. The receptor is the groundwater, not the abstracted water.

73. Although Report F1 refers to combining options, for example in relation to CLR11 in paragraph 2.4, it does not consider a combination of options to form the best practicable technique. This is too narrow an interpretation of the requirements, as the best practicable technique may mean a combination of more than one of the individual options. Report E, paragraph 2.8 specifically considers the combination of individual options to form the best practicable technique and this has not been adequately carried through into Report F1.

> *2.8 . . . The remediation and treatment options can be combined in a number of different configurations and different configurations may be appropriate at different points in time. . .*

73a. Reference to Best Practicable Technique or option in this DD for the Second Notice should be taken to include a combination of more than one individual option. This clarification addresses Affinity's comment at paragraph 16.9 of Annex B_Affinity with respect to S.3, Assessment Action 3:

> *It is acknowledged by the Agency at paragraph 73 of the Draft Decision that the Best Practicable Technique may mean a combination of one or more of the individual options. The wording used in this assessment action does not anticipate that the Best Practicable Technique may be a combination of multiple activities at various sites and should be adjusted accordingly.*

74. Carrying out pumping at multiple locations should accelerate the rate at which remediation will occur. The Second Notice includes Assessment Actions 4 to 8 to investigate the feasibility of scavenge pumping at additional locations to Bishop's Rise for the abstraction of bromate and bromide. A longer term pumping trial at Orchard Garage using an array of abstraction boreholes, and/or other location(s) is also required.

75. The need for the scavenge pumping from Bishop's Rise remains. The Agency has suggested a long-stop date of ten years in the Second Notice for the continuing monitoring and scavenge pumping, although this can be subject to further review. The Agency notes that this is the duration used for the scavenge pumping in the First Notice. It is also the interval used for abstraction licence renewal. The APs have suggested a period of 5 years in their proposed voluntary agreement/Remediation Notice which accompanied their consultation response. Affinity Water have requested consideration of a long term strategy (Annex B_Affinity, paragraph 9.6). Therefore the Agency has considered the views and decided to retain the 10 year period.

O.4 Treatment Options

76. The Agency accepts that the categorisation in Report F1 of the treatment options set out in Table 5 is a fair summary. The options that are shown in amber and green represent the possible best practicable techniques, either alone or in combination with each other. Those shown in red are: TA1. Reverse osmosis/Ultra and nano filtration; TA5. Electrolysis; TB3 Dosing for precipitation; and TC3. Biologically mediated reduction of bromate. However, the APs should reconsider the treatment options in Report F1 (Table 4) and the wider list in Report E (Table 2) with respect to the scenarios included in the Second Notice some of which could involve small volumes of pumped groundwater. Also, the possibility of using a treatment train, that is, a sequence of multiple treatments, combined with remediation options should also be considered.

77. With regard to the possible techniques that remain in Report F1, the Agency considers that for treatment for disposal information is available about treatment options TB4 (Chemical reduction of bromate) and TD1 (Disposal to Foul Sewer without pre-treatment). In the CD we stated that understanding will be adequately improved by the Bishop's Rise dosing and pumping trials. The dosing trial to address the practical difficulty of iron precipitation

blocking the discharge main is now complete and it is apparent that there are unanswered questions. (*HATR bromate ferrous chloride dosing trial, Summary report, April 2019*.) As TWUL mention, and the APs agree, at paragraph H.4 of Annex A_Thames further assessment of groundwater treatment by chemical dosing is required as part of the assessment actions. This will depend upon the approach(es) used in the assessment actions. Assessment Action 4 has been altered to reflect the views of the APs and TWUL. The objective of the trial was to assess the effect on sewage effluent quality of a reduced dosing rate. The ferrous dose has been brought down to 10mg/l and a staged increase in abstraction at the reduced dose rate, the pumping trial, started in mid-September 2018. Option TB4 is the current treatment used at Bishop's Rise. Option TD1 was used during the Orchard Garage pumping trial and this has provided useful information on the acceptability of discharging without pre-treatment. Therefore no further Assessment Actions for these treatment options are included at present.

78. The other two possible treatment options need further assessment, namely Option TB1 (Sorption of bromate and bromide by Granular Activated Carbon (GAC)) and Option TB2 (Ion Exchange). These two techniques need to be assessed with a view to treating the abstracted water to allow the water to be used as public water supply and for the other options, for example discharge to ground. The underlying question is whether the groundwater can be treated to the Water Regulations standard, or as close to that standard as would allow for its use when combined with other water (by blending). Paragraph 1.4(c) of the 2012 Guidance states:

> *1.4 The overarching objectives of the Government's policy on contaminated land and the Part 2A regime are:*
>
> *. . . (c) To ensure that the burdens faced by individuals, companies and society as a whole are proportionate, manageable and compatible with the principles of sustainable development*.

79. (Left blank in CD.)

O.5 The likely duration of the long term remediation

80. As discussed further in Section S below, the timescales for the Actions in the Second Notice mean that the specific Assessment Actions should be completed by 2021. At that point, there will be a further report to consider which option amounts to the best practicable technique. This will include considering the likely costs and the duration of the remediation required.

81. There has been little discussion to date about the overall timescale for remediation. The Agency is concerned that the current level of scavenge pumping is only reducing overall concentrations very slowly in the groundwater (see Report F1 and the appended monitoring database). Whilst actual timescales cannot be predicted with any certainty, the indications are that contaminant reduction will take a long time.

81a. The Agency has a duty under regulation 3 of the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (SI 2017 No. 407 (WFD Regulations), it "*must exercise its relevant functions so as to secure compliance with the requirements of the WFD*". The Agency also has a duty under section 78E(1) EPA such that it "*shall serve*" a remediation notice on an AP. In response to paragraph 82 of the Consultation Document, the APs maintain the regulation of contaminated land is not driven by the need to attain good status under the WFD. The wording of regulation 3 WFD Regulations, by the use of the word, "*must*", does not leave the Agency with the discretion to prioritise one duty over another. The Agency uses the tools provided by the EPA to remediate contaminated land but must, the word used in regulation 3, also comply with the WFD in applying the EPA. It is interesting to note that other duties imposed on the Agency by, for example, section 40 of the Natural Environment and Rural Communities Act 2006 and 6 and 7 EA leave the Agency with some discretion in the implementation of those duties. The wording of the Agency's WFD duty is more definite.

81b. Further, the Inspector for the Public Inquiry justified his approach to setting the RCS by reference to the WFD (IR878).

82. The Water Framework Directive 2000/60/EC (WFD) requires poor status water bodies to change to good status within 6 years (one WFD cycle). The Agency acknowledges that this is an aspiration and it is not necessarily achievable for groundwater in particular, where time-scales are longer. Recital 28 WFD states:

> *(28) Surface waters and groundwaters are in principle renewable natural resources; in particular, the task of ensuring good status of groundwater requires early action and stable long-term planning of protective measures, owing to the natural time lag in its formation and renewal. Such time lag for improvement should be taken into account in timetables when establishing measures for the achievement of good status of groundwater and reversing any significant and sustained upward trend in the concentration of any pollutant in groundwater.*

The current RBMP includes an alternative objective which extends the deadline from 2021 to 2027 for the change from poor to good status for the two affected groundwater bodies. This is on the basis that there would be disproportionate burdens or it would be disproportionately expensive to meet the 2021 deadline. It is however necessary to demonstrate that these remediation works are showing reasonable progress towards good status. The groundwater is a valuable resource that needs long term protection, for present and future generations (as reflected in AGP).

82a. The APs laid out the Agency's information on the background to the WFD status of the two affected groundwater bodies in Annex C_Crest, Appendix C8. The Agency comments on this at the end of Appendix 2.

O.6 Conclusion

83. Contamination is still entering the groundwater at SLCourt and the pollution of controlled waters remains significant. The Agency wants scavenge pumping at Bishop's Rise to continue in the manner set out in the First Notice until the Best Practicable Technique is determined. The further actions that are still necessary to determine the Best Practicable Technique are set out in the Second Notice as discussed below in Section S. The Agency envisage that the Best Practicable Technique will incorporate scavenge pumping at Bishop's Rise.

P. Possible Voluntary Remediation

84. On 18th January 2017, the Agency wrote to Crest and Redland to initiate discussion on remediation following 22nd July 2019. On 28th February 2017, Crest replied agreeing that voluntary remediation is preferable but that this should not be explored until the pumping trial at Orchard Garage (Action D3) was completed. On 3rd April 2017, Redland replied in similar terms.

85. On 16th August 2017 the Agency wrote to Crest and Redland to suggest some actions we would expect to see in a voluntary Remediation Statement that are not contingent on the results of the pumping trial. On 4th September 2017 Crest wrote to reiterate their position. On 20th December 2017, Redland also reiterated theirs. No proposals were forthcoming, even though Report D3 was finalised in June 2018, and Report F1 in July 2018.

85a. The APs first suggested voluntary remediation as part of their response to the formal consultation on the terms of the Agency's Second Notice, on 29th March 2019. The APs suggest a scheme for voluntary remediation (RS), as described in paragraphs 9 to 13 of their overarching summary document and the RS is a separate document. The Agency has considered these proposals and they include some useful ideas which have been applied in the final version of the Second Notice including on monitoring.

85b. As regards the other suggestions, the APs' draft Assessment Actions 4 and 5 relate to management and/or treatment at the abstraction points. These actions are not appropriate under Part 2A since they do not break the pathway in the SCL, neither do they remove the source or remediate the receptor.

85c. The Agency notes that the APs suggest the continued monitoring of the bromate and bromide plumes and of the groundwater and surface water monitoring of the bromate plume at their draft Actions 1 and 2, respectively, for a period of 10 years. Both of these actions are subject to a time limit exercisable at the APs' discretion after 5 years as described in paragraphs 1.5 and 2.3 of the RS. The Agency cannot accept this time limit.

85d. The Agency also notes that the APs suggest the continuation of scavenge pumping at Bishop's Rise at their draft Action 3. The time limit for this action has to be read in conjunction with their paragraph 4.4. Under paragraph 4.1, the APs will consider a revision

of the RCS. Paragraph 4.4 then entitles the APs to cease scavenge pumping if they assess that it is no longer necessary to meet the RCS as revised in accordance with paragraph 4.1. Whilst paragraph 4.1 places an obligation on the APs to request the Agency to determine the RCS it leaves the discretion to the APs to cease scavenge pumping. The Agency, as the regulator under the EPA, cannot agree to this.

85e. The APs propose at paragraph 5 an action to identify the infrastructure to determine how water can be treated. Assessment Actions 1 to 3 and 8 of the Second Notice cover this proposal and the Agency wants the review to be more comprehensive than as set out in their paragraph 5.

85f. The Agency has considered the merits of the APs' RS. The Agency is under a duty to serve a remediation notice, unless it is satisfied that appropriate things are being or would be done, without the service of a notice. In addition it can be noted that the APs have not secured any other rights, and a Voluntary Agreement would not allow for the powers under section 78G(2) EPA to be used. We are not satisfied that things would be done which would be likely to achieve a standard of remediation equal to, or better than, what is specified in the Second Notice, or within appropriate timescales.

86. Therefore it is still necessary to serve a further notice. The APs may propose further Remediation Statements which the Agency can consider to ensure that appropriate actions are undertaken by way of remediation.

Q. Liability

87. The Inspector's analysis of the identity of the APs and the findings at IR 937 to 938 and SoS 28 remain applicable. Circumstances have not materially changed nor has new evidence come to light.

88. The Agency, on the same basis, sees no need to revisit the apportionment of liability between the APs in the Inspector's Report (IR 961 to IR 971) and the SoS Letter (SoS 40 to 42). The apportionment of liability remains:

- Crest should bear 15% of the liability for bromate contamination and 55% of the liability for bromide contamination, and;
- Redland should bear 85% of the liability for bromate contamination and 45% of the liability for bromide contamination.

R. Compliance with the First Notice

89. Served with this document is the Second Notice. The Agency has considered whether actions in the First Notice need further work or not and what additional actions are required.

90. Some of the actions from the First Notice do not require further work at this time. These are Actions A, B, C and E and the outcomes are summarised below.

R.1 Action A of the First Notice

91. The report submitted by the APs to fulfil Assessment Action A of the First Notice *Report on the loads of bromate and bromide held in the strata beneath the site at St Leonard's Court, Sandridge* dated 4th June 2010, reference: LAF/SAN/CN/2702/01 (Report A) includes the conclusion:

> *6.3* It is concluded that while further information on the properties and distribution of contaminant mass in the source zone at the site would be of interest it will be difficult to design and undertake a further investigation. It is unlikely that even extensive *further investigation will significantly reduce the overall uncertainties in estimating the remaining mass of bromate and bromide in the source zone.*

92. The Agency responded to Report A in a letter dated 2nd July 2010. Following an exchange of correspondence, the Agency confirmed compliance in the letter sent by email on 26th August 2010. The report remains valid as there has been no change in the situation.

R.2 Action B of the First Notice

93. The conclusions of the report submitted by the APs to fulfil Assessment Action B of the First Notice, *Report on the mass flux in groundwater of bromate and bromide from the site at St Leonard's Court, Sandridge* dated 4th June 2010, reference: LAF/SAN/CN/2703/01 (Report B), includes the proposal:

> *6.4 A further phase of ground investigation is proposed to improve the vertical characterisation of contaminant concentrations in the plume and to determine the effective thickness of the plume down hydraulic gradient of the site. It is proposed that two boreholes are drilled in the vicinity of Orchard Garage down hydraulic gradient of the site.*
>
> *6.5 Based on the results of the additional ground investigation the need for a second phase of ground investigation will be assessed to determine whether an enhanced monitoring network is necessary in order to assess systematically changes with the mass flux with time and improving the design and performance of groundwater plume remediation options.*
>
> *6.7 . . . If the outcomes of the reviews carried out in accordance with Assessment Actions D and E result in any changes to the conclusions or proposals presented in this report further submissions will be made to the Environment Agency.*

94. The Agency responded to Report B in a letter dated 2nd July 2010 and endorsed the reference to further work in paragraph 93 above in its letter sent by email on 26th August 2010.

95. The APs undertook this proposed further site investigation at Orchard Garage in April and May 2014 and provided the results to the Agency (see OG Investigation).

96. The Agency considers the findings of the OG Investigation do not significantly change the assessment of the mass flux of contamination from SLCourt as presented in Report B.

R.3 Action C of the First Notice

97. The report submitted by the APs to fulfil Assessment Action C of the Notice *Review of the scope for modelling of the plume of bromate and bromide in groundwater associated with St Leonard's Court, Sandridge* dated 4th August 2010, reference: LAF/SAN/PDH/2704/01 (Report C) includes the recommendation:

> *7.9 Based on the review of the information available at the date of this report on the types of models with the modelling objectives it is concluded that there is no benefit in carrying out further modelling before further site investigation is undertaken and/or before a period of operating and monitoring a remedial treatment abstraction between SLC and Hatfield.*
>
> *7.10 . . . The benefits of further modelling should be considered when it is necessary to assess the effectiveness of a proposed remedial treatment action once some field based performance data are obtained. It is considered that the current models available for the modelling of contamination from SLC are not sufficiently reliable as predictive modelling tools for the identified objectives and consequently if modelling is used further work will be necessary to derive a suitable predictive model.*

The Agency responded to Report C in a letter sent by email on 26th August 2010, endorsing these two paragraphs.

98. Further modelling is reconsidered in Report F1, paragraph 8.23:

> *8.23 Based on the length of time which has elapsed since the initial release of contaminants in the source area and as the bromate concentrations in particular continue to be recorded at a number of monitoring locations significantly in excess of the bromate RCS, notwithstanding that removal of contaminant mass at Bishops Rise has been taking place for many years, it is considered likely that the length of time the concentrations of the contaminants in some parts of the plume remain elevated may be in the order of decades. Consistent with the report prepared in respect of Assessment Action C there are a number modelling approaches which*

could be used to simulate contaminant concentrations in the plume. While the appropriate use of modelling tools in the future to evaluate the effectiveness of remediation is not ruled out, it is considered that at this time and taking into account the uncertainties that remain in terms of the quantity and distribution of contaminant mass within the plume there is little justification for further detailed groundwater modelling of the plume.

The Agency agrees.

R.4 Action E of the First Notice

99. The APs submitted the following report to fulfil Assessment Action E of the Notice *Report on the review of any additional actions which could break the pollutant linkage or mitigate the effects with respect to groundwater contaminated with bromate and bromide* dated 4th August 2010, reference: LAF/SAN/CJC/2709/01 (Report E).

100. The Inspector summarises Assessment Action E in his report:

> *IR941 …This is not pollutant specific, but allows both Redland and Crest to identify possible alternatives to the treatment actions covered by Actions D1 and D2. It is for them to decide whether they wish to make such assessments, but the inclusion of this Action provides a means by which alternatives could be considered in deciding the best practicable technique.*

101. The Agency confirmed compliance in the letter sent by email on 26th August 2010.

102. The Agency considers that sufficient information is available and sees no benefit in repeating a remedial options appraisal at this time.

S. Actions in Second Notice

103. The Agency has set out actions in the Second Notice and anticipates that other notices may be required. At this stage, further Assessment Actions are needed whilst the Remedial Treatment Action, Action I, from the First Notice remains.

104. Table C compares the actions in the First and Second Notices. Figure D supports the table by showing the relationship between Assessment Actions 1-8 of the Second Notice.

105. There are four strands to the Second Notice: i) further assessment of remediation options; ii) further assessment of treatment options, including treatment to drinking water quality, with respect to bromine compounds (see list in paragraph 108 below); iii) continuing scavenge pumping at Bishop's Rise; and iv) monitoring actions. The findings of the Assessment Actions in the First Notice, in particular the final Assessment Action, F1 and responses to the consultation, are used to develop the actions in the Second Notice.

106. There are three new actions in relation to the assessment of treatment options.

107. What follows is an explanation of each assessment, monitoring and remedial treatment action and how these have been amended following the Consultation, beneath each action reproduced from the Second Notice.

108. Treatment of the abstracted water and use as water supply instead of the current discharge to foul sewer as waste is a more environmentally robust option. Therefore the Second Notice includes an assessment action to explore the options to treat water to drinking water standards with respect to bromate and bromide (to protect against formation of bromate, brominated and mixed chloro-bromo byproducts such as trihalomethanes (THMs) and halogenated acetic acids as a result of treatment processes (additional compounds as mentioned at I.3 of the Thames Water response). We acknowledge there are a number of practical difficulties to be overcome such as cost and ability to treat to meet drinking water standards, with respect to these bromine compounds, and possible locations where the treatment could take place. Additionally, the consultation response from TWUL mentions management difficulties in the use of treated water for supply (Annex A_Thames, paragraph G.2).

108a. There is a mutuality of interests between the Agency on the one part, Affinity and TWUL on the second part and the APs. The Agency wants to see SCLs broken. The sooner the aquifer is remediated, the sooner Affinity can use it for public water supply and the threat to the NNR wells is removed.

108b. The Agency expects both Affinity and TWUL to provide information to APs which they request. The APs have requested help, for example at paragraph A.2 of Annex A_Thames. At paragraphs 3.5c and d of Annex B_Affinity, Affinity offer to share their knowledge and expertise. Any confidentiality issues can be dealt with by an agreement such that the APs

do not release the information. All parties can also participate fully in the Bromate Treatment Working Group to allow for the free exchange of information.

108c. The Second Notice also seeks a further pumping trial and an investigation of the water treatment possibilities. The Agency expects both Affinity and TWUL to engage in the remediation process by working collaboratively with the APs to facilitate the completion of the actions in the Second Notice.

108d. The Agency will consider not only the information supplied by the APs through an assessment action but also other information we consider relevant. Additionally, the Agency expects the APs to keep output from assessment actions under review with respect to technological advancements.

109. The actions are largely based on the findings of Report F1 and Consultation responses with the exception of the APs' suggestion that the core of the plume mass has migrated significantly down gradient such that scavenging in the upper part of the plume is of limited benefit. Report F1 states:

> 8.7 …*Based on the observed monitoring data trends, by the time that the installation of abstractions might be achieved the concentrations of the contaminants in the groundwater will have reduced further and any benefit associated with contaminant mass removal at this location would be even less than currently.*

The Agency does not believe sufficient evidence has been provided to justify this hypothesis, as explained above in Section O.2, paragraphs 64 to 67. However, in the light of the APs' additional evidence the Agency agrees, as explained in paragraph 67 above, that optimised scavenge pumping at Bishop's Rise should be sufficient for hydraulic containment and that replication in the upper part of the plumes is of limited benefit.

109a. The Agency's view is that one main scavenge pumping site may be sufficient. The primary aim of scavenge pumping is to provide hydraulic containment but as the APs show in their response, useful amounts of contaminant are also removed. Another site would be duplication and the APs have shown that Bishop's Rise is an effective place to scavenge pump (Annex C_Crest, paragraphs 65 to 68).

109b. Therefore at up gradient sites the Agency's emphasis has altered from abstracting high volumes of water to that of maximising contaminant removal and takes into consideration the APs' comments that large volumes of water may exceed sewer capacity at paragraph 82 of Annex B_Crest. Although not completely effective, hydraulic containment at Bishop's Rise provides a protective barrier so that other remedial activities can take place with minimal risk to the aquifer down gradient of Bishop's Rise. Such activities can include removal and re-introduction of treated groundwater including focussed removal from specific fissures. This approach minimises volumes abstracted and discharged to sewer.

109c. A targeted approach in locations with a high concentration of contaminants may have the added benefit of reducing pore water concentrations more quickly than under natural processes and prevent their migration down gradient. The significance of secondary sources (ie, where concentrations are higher in the pore water than in the fissure water) is unknown. The Agency refers to the only evidence available which is at Orchard Garage and shows that secondary sources within the saturated zone do not appear to be a feature there.

109d. Further detailed explanation is given in paragraphs 62 to 67 of Appendix 2.

110. The times provided for completion of Assessment Actions and deadlines for reports are similar to those in the First Notice.

110a. Following a comment from the APs (Annex B_Affinity, paragraph 3.5c) in response to Affinity's proposal that they should be consulted on assessment actions as they progress, the Agency confirms that they anticipate forwarding the APs' reports on actions to the Water Companies unless the APs send the reports to the Water Companies direct.

110b. The Agency agrees with the APs that the Water Companies are not the regulator. Affinity provided an additional consultation response, Affinity_Further. This response comprises mainly drafting changes to the proposed actions. This includes requirements for consultation with Affinity which the Agency does not accept.

110c. Schedule 5 of the Second Notice gives details of apportionment between the two APs. This is the same as for the First Notice. Redland bear 85% of costs associated with the bromate SCL and 45% of cost associated with the bromide SCL. Crest bear 15% of costs associated with the bromate SCL and 55% of the costs associated with the bromide SCL. Based on this, the percentages of the actions are assigned to each of the APs. Table C shows how these match the actions of the First Notice. Assessment Action 1 is assigned only to the bromate SCL because in some cases bromide may not need treatment and because whether bromide is there or not, the Agency considers that this will not affect the choice of treatment method(s). On the other hand, in relation to treatment costs, bromide may add an additional burden. Therefore, the relevant apportionment and the SCLs for Assessment Action 5B is the same as that for Assessment Action 4.

S.1 Assess the feasibility of treating the contaminated groundwater for public water supply or similar quality standards

1. An Assessment Action must be undertaken as below:

a. Assess the feasibility of treating groundwater for bromine compounds from locations within the bromate plume between SLCourt and Bishop's Rise. The locations are: Orchard Garage, Harefield House, Nashes Farm, Hatfield Quarry and Bishop's Rise. Treatment is to use:

(A) Granular Activated Carbon (GAC)

(B) Ion Exchange

(C) Combinations of treatment options, not necessarily limited to A and B.

In each case:

(i) Assess the before and after treatment concentrations for a range of starting concentrations found within that part of the plume, by bench tests, results of a literature search and communications with the water industry, to provide reliable estimates;

(ii) Assess: residence times; the availability of appropriate businesses where the media, (A) GAC and (B) Ion Exchange resin, can be sent for regular regeneration;

(iii) Assess plant installation costs for (A), (B) and (C) above;

(iv) Assess annual running costs for (A), (B) and (C) above.

(v) Assess the feasibility and cost of running pilot plant scale tests for treatments selected from the results of assessments (i) – (iv) above.

b. Report on the outcome of (a) above to the Agency in writing.

This Action must be completed within four months of the date of this notice.

111. If treatment and use of abstracted water for Raw Water supply is a feasible option, maximising the removal of mass is not the only criterion to consider. It may be that treatment of a lower starting concentration enables drinking water quality, with respect to bromine compounds, to be attained thereby ensuring a more cost effective solution for long term pumping than discharge to sewer.

111a. The Agency has narrowed down this assessment action from the CD version by specifying locations. These locations are representative of the concentrations encountered within the upper part of the plumes. Contaminant concentration will affect treatment method and cost.

111b. At paragraph 5.7 of Affinity's further response (Affinity_Further) there is mention of pilot plant scale tests. The Agency think this is helpful and therefore we have added an assessment action, 1a(v). In response to the results of the assessment action, the Agency may include a pilot test(s) in a future notice.

111c. Action 1 is now not restricted to the assessment of abstracted water as Raw Water for public supply but is also to inform a range of disposal techniques including the potential for injection to ground. This is not an additional burden, the Agency is simply seeking to widen the applicability and therefore the change does not require further consultation. As mentioned in paragraph 116a below, this is a change brought about by consultation responses which point out some of the difficulties in use of the treated water for public supply or discharge to sewer. This approach is followed through in subsequent actions.

112. The APs only need consider the different concentrations within the plume.

112a. In their consultation response, TWUL (Annex A_Thames, paragraph J.1) consider that this treatment assessment action should be extended to include pre-treatment ahead of

discharge to sewer. The Agency agrees that the assessment should include this, especially if it could mean that the need for further sewer modelling can be avoided. It may, as the APs suggest in their response to TWUL's comment, prove to be disproportionately expensive but assessment is needed so that informed choices can be made.

112b. In their consultation response, Affinity (Annex B_Affinity, paragraph 16.5) suggest that all aspects of drinking water quality requirements should be considered. The Agency disagrees and have clarified any possible ambiguity by qualifying the reference to drinking water quality by adding with respect to bromine compounds in this document. Any other required treatment would have to be carried out at the Water Companies' own treatment works. However, as shown by the groundwater water analyses taken at the time of the pumping trial, apart from bromine compounds, the groundwater in the vicinity of SLCourt is generally of good quality (Report D3c, Appendix N).

112c. Affinity suggest additional sites should be considered (16.6), including downstream of the plume. Assuming that downstream of Bishop's Rise is what is meant, identifying useful sites, if any exist, would be very difficult downgradient of Bishops Rise. The reason for this is that there is very little information on contaminant concentrations in the area affected by the North Mymms swallow holes and the associated fissure system up gradient of the NNR wells.

113. Paragraphs 2.5 and 2.7 of *Report on the Assessment of Potentially Suitable Locations for the Abstraction and Disposal of Groundwater Contaminated with Bromate and Bromide*, Report dated 4th June 2010 to comply with Actions D, D1 and D2 in the First Notice (Report D) suggest Orchard Garage, Harefield House, Hatfield Quarry and Bishop's Rise itself as scavenge locations. The Agency suggests these three as potential locations for abstraction and treatment but Nashes Farm must also be considered.

114. GAC and ion exchange are the two feasible treatment options identified in Report F1 as alternatives to dosing with ferrous chloride as currently used at Bishop's Rise. The APs comment on action 1 in Annex A_Crest that an action to assess GAC and ion exchange is not needed. For this reason Action 1a(c) has been added to open the assessment out to other possible treatments referred to in Reports E and F1 and to a combination of treatment options, or a treatment train. For example, reverse osmosis may not be suitable on its own but followed by other treatments, it may be feasible. Thus reference to a "treatment plant" in the Second Notice may include a series of treatments. Also as explained at paragraph 76, treatment techniques need to be reconsidered for different scenarios.

115. The Action relates to treatment for public water supply, injection to ground or discharge to sewer, or a combination of these. The Agency is not aware of any other feasible means of disposal or use for the quantity of water likely to be abstracted at this time. However, discharge to surface water sewer or river should not be ruled out. Paragraph 7.33 of Report F1 mentions the option (TD2) but only in relation to SLCourt or Bishop's Rise. The Agency agrees that discharge to surface water is not feasible at these locations but may be possible at Hatfield Quarry, for example. Any return direct to the environment is likely to require a

similar standard of treatment. If other uses are identified and proposed, the Agency will consider these.

116. Bromate is an unusual substance to be treating, certainly at the concentrations encountered within the contaminant plume. Therefore suitable facilities for regenerating GAC and/or ion exchange media for subsequent re-use need to be identified.

S.2 Assess locations in the vicinity of Bishop's Rise and up gradient for a treatment plant and the feasibility of connection to the raw water public water supply network and/or means of disposal.

2. An Assessment Action must be undertaken as below:

a. *Assess locations in the vicinity of Bishop's Rise, Orchard Garage, Harefield House, Nashes Farm and Hatfield Quarry for the installation of a treatment plant which could be installed and operated to allow connection to Affinity's raw water supply network and/or connection to an injection borehole(s), surface water and/or the sewer network.*

b. *For each treatment plant location, and each treatment method in 1, estimate costs including:*
   (i) Acquiring legal rights to carry out the operation at that location;
   (ii) Installing treatment equipment;
   (iii) Providing a pipeline connection from the abstraction borehole(s) to the location;
   (iv) Providing a pipeline connection to a suitable point on the raw supply network which has adequate capacity for the anticipated flow;
   (v) Recurring annual operations;
   (vi) Providing and maintaining injection boreholes;
   (vii) Providing a connection to a suitable sewer.

c. *For each treatment plant location estimate the maximum rate of abstraction that could reasonably be achieved and assess the likely rate of removal of bromate and bromide from the aquifer.*

d. *Identify any alternatives to the arrangements outlined in (a) - (c) above that might achieve the same objective of removing bromate and bromide from the aquifer and dealing with the abstracted water.*

e. *Report the outcome of (a) - (d) above to the Agency in writing.*

This Action must be completed within four months of the date of this notice.

116a.Report F1 refers to ***TD3. Discharge to land*** at paragraph 7.35:

> *7.35 As the volumes of abstracted water are likely to be relatively large, the likelihood of the water infiltrating to groundwater or flowing overland to a local surface watercourse rather than absorbed into the shallow soils and or evaporated will be high. The concentrations of contaminants in the water which would be discharged to land might exceed the tolerance levels of the flora and fauna dependant on the land to which the water is discharged. A large area of land would be needed and no suitable location is readily available therefore identifying and obtaining permission to use an area if it can be identified is unlikely to be practical as a result of geographical, legal and land access constraints. . . .*

These constraints apply to shallow soils and the Agency agrees that surface infiltration is not practicable for the reasons given. In any event this method would be unacceptable as it may lead to bromate contamination of the shallow aquifer. The Agency normally only accepts the return of groundwater to the same aquifer from which it was abstracted. Following the consultation and as discussed above, sub-sections 2a and 2b of the assessment action have been altered to allow for discharge to the Chalk aquifer from which the water was abstracted. This is followed through in sub-section 2d of the action. The practical difficulties, including those of using the sewerage and water main infrastructures, have led the Agency to the view that, although not ideal in some respects, injection to the aquifer following treatment now needs to be included amongst the options to be considered.

116b.TWUL point out that even if treated water was to be used for Raw Water supply, outages of the water treatment process, or low customer demand for potable water would mean that an alternative disposal route would also need to be provided. In Annex A_Thames, G.2.c TWUL suggest this would be the sewer, but injection to the aquifer should also be considered for treated water.

116c.A clarification has been added to 2a of the assessment action that treated water is to enter Affinity's Raw Water supply, not the potable supply, following consultation responses from both the APs and Affinity. The APs state that they have no remit to provide drinking water for public supply (Annex A_Crest, paragraph 78). Whether they can or not, this is not what the Agency intended by the action. As mentioned in paragraph 112b above, Affinity stated that the water would need to be treated for other contaminants to ensure it met drinking water standards. As the APs mention at Annex B_Affinity paragraph 16.5 in their response to Affinity's response, this is unreasonable. The Agency's view is that Affinity's suggestion is outside the requirements of Part 2A and the intention is that there should be pre-treatment for bromate and bromide only.

116d.As explained during the site meeting attended by Affinity, TWUL, the APs and the Agency on 3rd January 2019, there is a water pipeline that runs between Bishop's Rise and North Mymms where raw water is treated. Details were provided in an email from Affinity dated

22 February 2019. Therefore a treatment plant could be located in the vicinity anywhere along its length.

116e. The APs are not averse to water from scavenge pumping at Bishop's Rise being used for public supply. At H.4 of Annex A_Thames they comment that management of higher volumes of abstracted water could comprise the return of a proportion of the water to public supply and a proportion to sewer.

116f. In view of the site-specific technical, operational and logistical delays (for example referred to in Annex A_Crest, paragraph 59), the Agency wishes to ensure greater flexibility for the location of a treatment plant.

117. This action will require consideration of the amount of land required, planning requirements and cost of acquiring leasehold or freehold land. The location must allow connections to the abstraction site(s) and the water undertaker's Raw Water supply network.

118. Report F1 states:

> *8.16 Discussions will be necessary also with the Water Companies to identify the presence of the pipework infrastructure that could be used to convey the treated water to the supply system. As Bishops Rise was used for supply prior to the introduction of the drinking water limit for bromate it is assumed that this infrastructure is in place. Any works carried out on Water Company property would need to be done by or on behalf of the Water Companies therefore close liaison and discussion will be necessary to agree with them the approach to and selection of the best practicable technique. Depending on the nature of the planning consent in place for the Bishops Rise site, it may be necessary to apply for planning permission to accommodate a treatment plant.*

119. The Agency agrees that any pre-treatment of water for public supply needs close liaison with the Water Companies. In addition, with the Bishop's Rise abstraction coming up for renewal in 2019, consideration will need to be given to the terms of the licence or the licence varied after issue.

119a. As the Agency cannot define the detail this is an assessment action, not a remedial action.

S.3 Identify the best practicable technique

3. An Assessment Action must be undertaken as below:

a. Using the information gained from actions 1 and 2 above:
(i) Assess the practicality, effectiveness and durability of each option;

(ii) Evaluate including by comparison of the cost benefit analysis for each option, which option amounts to the best practicable technique and provide the reasons for that assessment.

b. Report the outcome of (a) above to the Agency in writing.

This action must be completed within two months of completion of the reports required under actions 1 and 2 above.

120. For the avoidance of doubt, the APs must consider what regulatory hurdles have to be overcome. In Annex A_Crest, the APs questioned the need for this to be included in the action as they assume the Agency is better placed to comment. It is reasonable to expect the APs to anticipate the necessary consents required as with any other development.

121. Where no best practicable technique can be identified, the report will explain the reasons for this.

122. The following actions (4)-(7) reflect, but are a progression from, those in the First Notice.

S.4 Assess scavenge pumping from a borehole array at Orchard Garage and other sites

4. An Assessment action must be undertaken as below:

a. Assess for Orchard Garage, Harefield House, Nashes Farm and Hatfield Quarry, a scavenge pumping trial of one year's duration from borehole(s) to remove bromate and bromide from the plume.

b. Estimate the costs of:
(i) Acquiring legal rights to carry out the operation;
(ii) Installing suitable boreholes and pumps, or adapting the existing boreholes and pumps;
(iii) Providing a pipeline connection to enable disposal of the abstracted water;
(iv) Recurring annual operating and other costs, excluding any costs related to treatment of the water to remove bromate and bromide, or reduce bromate to bromide, and the chemical loading element of any trade effluent or other charges.

c. Estimate the maximum rate of abstraction that could be achieved within the constraints above, and assess whether this is likely to be the optimal rate to maximise removal of bromate and bromide: a) from the aquifer, and b) from the pumping trial location(s).

d. Assess low flow rate scavenge pumping from selected existing boreholes which show high contaminant concentrations at SLCourt or alternative locations proposed to, and approved by the Agency in writing.

e. Identify any alternatives to the arrangements outlined in (a) - (d) above that would achieve the same objective of removing bromate and bromide from the aquifer.

f. Report the outcome of (a) - (e) above to the Agency in writing.

This action must be completed within four months of the date of this Notice.

123. This Assessment Action is similar to Assessment Action D in the First Notice but provides for a longer pumping trial. The reasons are given in paragraph 126 below. The Agency acknowledges that conditions are not ideal for maximum removal of contaminant at Orchard Garage as the APs comment at action 4 in their Annex A_Crest but the preliminary work has been undertaken much of which would have to be done again at other locations. It is for this reason and the comment made in Annex A_Crest, that resources could be better deployed in scavenge pumping lower down the plume, that a number of locations are now specified in the assessment actions. Report F1 mentions barriers to any form of scavenge pumping other than at Bishop's Rise (paragraph 8.6).

123a. Action 4 is to be undertaken in parallel with Actions 1 and 2.

123b. Action 4a has been changed from the CD to make it more logical and move the emphasis from groundwater abstraction to contaminant removal, as discussed in paragraph 67 above.

123c. Greater flexibility has been added to actions 4a and 4b(iv) to allow for treatment to remove bromate and bromide, not only reduce bromate to bromide, in line with the changes made to the preceding assessment actions.

123d. Action 4d has been added to allow small-scale low flow scavenge pumping from SLCourt. This has been introduced following the consultation response from Affinity for remediation at SLCourt itself (Annex B_Affinity, paragraph 3.5b). The Inspector stated:

> *IR844 There is no suggestion that the land at SLC should be remediated because of the use that land is put to.*

However, some scavenge pumping from existing boreholes should be achievable with little disturbance to the residents. This is not in conflict with paragraph 69 above since it is assumed that the reference to abstraction at the source (Report F1, Table 5) referred to a full-scale scavenge pumping. Part of Affinity's reason for asking for remediation at SLCourt is the effect of high groundwater levels. The Agency now agrees with the APs that the evidence does not support groundwater levels as the sole reason for trends in contaminant concentrations.

123e. However, some work at SLCourt is worth pursuing since groundwater bromate and bromide contaminant concentrations remain high in certain boreholes on SLCourt itself. For example at boreholes GW 3 and GW10. Bromide concentrations are high at borehole

5. The Agency envisages that the water discharged would be removed from site in IBCs (Intermediate Bulk Containers) or similar for disposal at an appropriate facility.

123f. The scavenge pumping may have the added advantage of providing an indication of the volume of contaminated water present and the relative proportions within fissures and pores within the saturated Chalk.

123g. With respect to action 4e (4d in the CD) the APs comment in Annex A_Crest that *the objective is not simply 'removing contaminants from the aquifer'* (now changed to bromate and bromide for clarity). The Agency agrees that ultimately the objective is not simply removal of bromate and bromide from the aquifer but removal to agreed standards. However this is an assessment action forming one of the steps towards identifying a reasonable remedial action.

123h. Affinity refer to the need for more intensive monitoring for specific actions such as the pumping trial (Annex B_Affinity, paragraph 16.12) and TWUL mention at Annex C_Thames, paragraph F.1 the need for monthly monitoring during the trial. The Agency agrees this is likely but such monitoring would form part of the trial methodology and therefore does not require specific mention here.

124. Paragraph 2.5 of Report D includes Orchard Garage as one of the single abstraction location candidates near to the centre line of the bromate and bromide plumes. Report F1, paragraph 8.4 records that the . . . *pumping trial at Orchard Garage demonstrated that pumping to abstract groundwater at the practicable flow rates did not pull in groundwater with higher concentrations of contaminants from the surrounding aquifer*. This lends weight to the assertion that Orchard Garage is near the centre line of the plumes where concentrations are highest.

125. Report F1, paragraph 8.5 states:

> *8.5 Scavenge pumping in the vicinity of Orchard Garage would have potentially been an effective and sustainable location when the concentrations of the Contamination were higher. However, as the concentrations of the Contamination at Orchard Garage now are reducing and are lower than the concentrations in the groundwater further down gradient, such as at Bishops Rise, the area around Orchard Garage is no longer considered the best location for removing contaminant mass in the most effective way. Whilst scavenging abstraction(s) in the vicinity of Orchard Garage would remove some contaminant mass, as there are higher concentrations of contaminants in the groundwater down gradient of Orchard Garage it is likely to have limited direct benefit in providing protection to the public supply abstraction wells. The relative concentrations of bromate and bromide in the plume over time along the approximate centreline of the plume are shown on Figures 4 and 5 respectively.*

126. A longer test would show: how concentrations vary with seasonal groundwater level change under pumping conditions; and would demonstrate the value or otherwise of

pumping from Orchard Garage and other sites. It would also allow time to vary the pumping rate for long enough to see the effect of different pumping rates on contaminant mass removed.

127. The trial could also involve pumping from a number of boreholes on the site, thus capturing a higher proportion of the plumes and allowing for pumping and non-pumping periods at individual boreholes depending upon bromate and bromide concentrations in the abstracted water. Boreholes were drilled on the Orchard Garage site as part of the site investigation and to provide observation boreholes for the completion of action D3 of the First Notice. They are unlikely to be suitable as pumping (or injection) boreholes and therefore additional boreholes may need to be drilled at Orchard Garage.

128. The Second Notice now specifies locations for the assessment action as described in paragraph 113 above. Following the invitation in the CD, no other suggested locations were received from consultees.

129. Similarly, a pumping trial may use a multi-location arc of boreholes. Locations such as Orchard Garage, Harefield House and Hatfield Quarry as suggested in Report D at paragraph 2.5 are not ideally placed to capture groundwater across the width of the plumes but do have the advantage that they could all be joined by connecting pipework with a discharge to the House Lane sewer subject to TWUL's agreement.

130. Report D at paragraph 2.7 included a further array close to Hatfield Quarry, known as Group 2 and shown in Figure 1 of the report. This location has the advantage of boreholes forming an arc across much of the width of the plumes. The Agency accepts that there may be practical difficulties such as the current distance to a suitable sewerage system. Hatfield Quarry has many advantages, including land availability and current groundwater abstractions which may provide information on aquifer properties in the vicinity (ref).

131. There may be other potential sites for scavenge pumping which become apparent if new information emerges. For example, although the significance is not understood at present, the Agency has recently been made aware of the possible extent of dewatering to maintain water levels below the A1(M) cut-and-cover road tunnel in Hatfield. We are in the process of obtaining further information as a recent change in legislation means that this dewatering activity may now require a licence. The Agency has been unable to obtain any further information on this site since production of the CD.

S.5 Assess cost of scavenge pumping from an array of boreholes at Orchard Garage and other sites

5A. An Assessment Action must be undertaken as below:

a. In relation to Action 4 above assess for Orchard Garage, Harefield House, Nashes Farm and Hatfield Quarry, estimate:

(i) The cost of installing any treatment plant required to reduce bromate to bromide;

(ii) *Annual operating costs associated with the treatment plant, including any fees for an associated mobile treatment permit, and for a longer term Environmental Permit;*
(iii) *Annual trade effluent charges relating to discharge of the products of treatment to reduce bromate to bromide.*

b. *Report the outcome of (a) above to the Agency in writing.*

This action must be completed within four months of the date of this Notice.

5B. An Assessment Action must be undertaken as below:

a. *In relation to Action 4 above for Orchard Garage, Harefield House, Nashes Farm and Hatfield Quarry estimate:*
(i) *The cost of installing any treatment plant required to treat bromate and bromide;*
(ii) *Annual operating costs associated with the treatment plant, including any fees for an associated mobile treatment permit, and for a longer term Environmental Permit for treatment;*
(iii) *Cost of constructing a pipeline to the point of discharge;*
(iv) *Cost of constructing discharge boreholes;*
(v) *Environmental Permit charges for discharge of treated groundwater.*

b. *Report the outcome of (a) above to the Agency in writing.*

This action must be completed within four months of the date of this Notice.

132. This action is similar to Assessment Action D1 in the First Notice. It relates to assessment of costs for a longer term pumping trial, and further explanation is given under Assessment Action 4 (S.4 above).

132a. Action 5A relates to scavenge pumping and treatment of bromate by reduction to bromide prior to discharge, for example to sewer; Action 5B relates to scavenge pumping and treatment of both bromate and bromide. Action 5 of the CD has been split in this way for clarity and because the apportionment for the two sub-actions is different. The apportionment of action 5A remains as it was for action 5 in the CD, whereas action 5B has the same apportionment as action 4. It is a shared common action with an apportionment of 65% to Redland and 35% to Crest. This is because treatment of both bromate and bromide may be necessary to meet, say, drinking water standard and RCS respectively. These are the standards (or close to them) which are likely to be appropriate for use as a raw water supply, or for discharge direct to the environment. Action 5B thereby links to assessment action 1, see S.1 above. As explained in paragraph 116a there is greater emphasis on treatment to a higher standard than there was in the CD. Action 6 deals with the cost of discharge and disposal of the bromide contamination alone.

S.6 Estimate costs of discharge and disposal of scavenged groundwater

***6. An Assessment Action must be undertaken as below**:*

a. In relation to action 4 above, for Orchard Garage, Harefield House, Nashes Farm and Hatfield Quarry, estimate the annual costs relating to the discharge and disposal of bromide-contaminated water to the foul sewer and/or by some other means, excluding bromide resulting from the reduction of bromate.

b. Report the outcome of (a) above to the Agency in writing.

This action must be completed within four months of the date of this notice.

133. This action is similar to Assessment Action D2 for the pumping trial in the First Notice.

134. Therefore the Second Notice includes Assessment Actions to investigate the feasibility of remedial pumping at locations additional to Bishop's Rise for the abstraction of bromate and bromide. As explained in paragraph 63c, such a scheme is necessary to remove bromate and bromide from the upper part of the plumes. Even if these sites are not as effective as Bishop's Rise as the APs suggest at paragraphs 65 to 68 in Annex C_Crest, an additional site, or sites, is likely to speed up remediation.

S.7 Report on one year's scavenge pumping trial

7. An Assessment Action must be undertaken as below:

a. Carry out a review of the findings of actions 1, 4, 5A, 5B, and 6, and using the results from action 1.

b. Based on the review, proposals for a scavenge pumping trial shall be submitted in writing, for approval in writing within five months of the date of this notice.

c. Carry out the agreed scavenge pumping, to find the most effective means of removing bromate and bromide, in line with an abstraction licence (if required), and dispose of the pumped water arising from the trial without adverse environmental effects, unless otherwise agreed with the Agency in writing.

d. The outcome of the trial shall be reported to the Agency in writing.

This action must be completed within fourteen months of approval by the Agency under (7b), unless otherwise agreed in writing by the Agency.

135. This action is similar to Assessment Action D3 of the First Notice, although there is now a defined list of potential sites and the power to call on section 78G(2) EPA has been retained.

135a. A low flow pumping regime would not require an abstraction licence if below 10m3/day. Therefore the words: "*if required"* have been added.

135b. In response to the APs comments in Annex A_Crest, section numbering has been introduced and some wording re-ordered for clarity and consistency with the format of the other actions in the Second Notice. Some further explanation of the interrelationship between actions is given in paragraph 136c below. See also Figure D.

135c. Assessment Action 2 relates primarily to the location of a long term treatment plant and therefore is not specifically mentioned in 7(a). However, the findings may be of benefit in the design of the trial. Assessment Action 3 is intended for the long term scavenging proposal but may also inform Assessment Action 7. Conversely, the findings of Assessment Action 7 may influence the best practicable treatment technique and so Assessment Action 3 and Assessment Action 7 are to be drawn together in Assessment Action 8 below.

S.8 Report F1 update

8. An Assessment Action must be undertaken as below:

a. Taking account of the information gained from actions 1-7 above and the information gained from actions taken under the First Notice:

(i) Assess or update the practicality, effectiveness and durability of each option, individually and/or in combination, as appropriate;

(ii) Evaluate, including by comparison of the cost benefit analysis for each, which option individually and/or in combination amounts to the best practicable technique and provide the reasons for that assessment;

(iii) Update and refine the conceptual model;

(iv) Assess the effectiveness of the scavenge pumping at Bishop's Rise and propose improvements to maximise hydraulic containment and contaminant removal.

b. Report the outcome of (a) above to the Agency in writing by means of an update of Report F1.

This action must be completed within two months of completion of the report required under action 7 above.

136. This Assessment Action brings together the findings of Assessment Actions 1-7 to establish the best practicable technique which may well comprise a combination of options in addition to improved pumping at Bishops Rise.

136a. Report F1 included an update of the conceptual model. A requirement to update and refine the conceptual model has been included as 8a(iii) for clarity.

136b. Affinity's dosing trial report referenced in paragraph 77 above makes recommendations with respect to the current Bishop's Rise scavenge pumping (see paragraph 148a below). Improvements are required and therefore sub-action 8a(iv) has been added. This assessment should take the findings of the dosing trial report into consideration.

137. Even if additional pumping sites are not as effective as Bishop's Rise, as mentioned in paragraph 134 above, they are likely to increase the overall speed of remediation.

138. This action is to include full costings within the cost benefit analysis of each option to allow a cost effectiveness assessment. See paragraphs 63 to 63g, Section O.1.

S.9 Groundwater monitoring of the bromate and bromide plumes

9. A Monitoring Action must be undertaken as below:

a. Provide quality-assured monitoring data at the locations identified in Table 1 below for the parameters, and at the frequencies, listed in Table 2 below, unless otherwise agreed in writing with the Agency.

Table 1. Locations to be monitored under Monitoring Action 9

Location reference	**Site name**	**Type[1]**	**NGR***
080	MW2, St Leonards Court	M	TL 17070 10455
223	SLC10, St Leonard's Court	M	TL 17134 10440
082	MW4, St Leonard's Court	M	TL 17121 10427
081	MW3, St Leonards Court	M	TL 17096 10435
083	MW5, St Leonards Court	M	TL 17074 10411
216	SLC03, St Leonards Court	M	TL 17080 10475
028	Orchard Garage	P	TL 17500 10300
028b	Orchard Garage MJCA BH1	M	TL 17507 10293
028c	Orchard Garage MJCA BH2	M	TL 17510 10305
028d	Orchard Garage MJCA BH3	M	TL 17561 10316
225	GW12, top of House Lane	M	TL 17152 10365
226	GW13, Harefield House	M	TL 17748 10035
227	GW14, beside Jersey Farm pond	M	TL 17754 09706
019	Nashes Farm	P	TL 18000 09600
166	Hatfield Quarry, WPG16	M	TL 20241 09741
162	Hatfield Quarry WM3B	M	TL 19283 08858
061	Hatfield Quarry WM4	M	TL 19661 09103
062	Hatfield Quarry WM5	M	TL 20175 09499
064	Hatfield Quarry WM7	M	TL 19900 09275
066	Hatfield Quarry WM10, lower level (P2)	M	TL 20051 09393
402	Comet Way BH5	M	TL 21760 08911
002	Hatfield Business Park	P	TL 21350 09795
001	Hatfield PWS BH	PWS	TL 22000 07700

Notes to Table 1:
**Precise locations of abstractions are masked*
[1]M – monitoring borehole, P – private water supply, PWS – public water supply

Table 2. Parameters to be measured and frequency of measurement

Controlled waters	***Frequency***	***Parameters to be measured (see Table 3 for abbreviations & symbols)***
Groundwater in, or in continuity with, the Chalk aquifer	*4 times per calendar year* in January, April, July, & October*	*pH, EC, Cl, Na, BrO_3, Br, Temperature, DO, Redox potential, Water level AOD, Depth to base of borehole where feasible.*
Surface waters	*4 times per calendar year* in January, April, July, & October*	*pH, EC, Cl, Na, BrO_3, Br.*

*Note to Table 2: * pro rata per part of calendar year*

b. Update the Method Statement completed for Action G of the First Notice so that it is in accordance with relevant British Standards, and paragraph (c) below, unless otherwise agreed in writing by the Agency. Specify in the Method Statement the precision, bias

and limit of detection to be achieved for each parameter monitored. Submit the method statement to the Agency for approval prior to sampling commencing.

c. *Analysis of samples is to be carried out by a laboratory accredited to ISO/IEC 17025 and using United Kingdom Accreditation Service accredited methods, performance-tested in accordance with Water Research Centre plc (WRc) publication NS30, 'Analytical Quality Control in the Water Industry' (WRc Report NS30, June 1989, ISBN 0902156853). The laboratory will operate a system of routine analytical quality control, preferably based on the use of control charts (see WRc Report Ref: Co4239 'Quality Control Charts in Routine Analysis'). Samples must be analysed within 72 hours of collection.*
d. *Results are to be reported to the Agency no more than six weeks after sampling and measurement, in a summarised format to be agreed in writing by the Agency, accompanied, where relevant, by laboratory certificates of analysis, which must state the associated measurement uncertainty.*

This action must be started within three months of the date of this notice and continued for ten years or such shorter period as may be agreed in writing by the Agency.

139. Continued monitoring is required in order to assess both the effects of remediation on the plumes and other variations in the extent of the plumes and contaminant concentrations. Monitoring is reduced to quarterly now that there is a substantial set of baseline data. This frequency is in line with what the APs have been doing voluntarily since the completion of Actions G and H in the First Notice. The period of monitoring is the same as for the scavenge pumping at Bishops Rise.

140. MJCA BH1, BH2 and BH3 are added to Table 1. These three boreholes were drilled as part of the OG Investigation and formed observation boreholes during the pumping trial. Longer term monitoring of these boreholes will improve understanding of the contaminant distribution and temporal variation at Orchard Garage. The data will be particularly valuable for any longer term pumping trial at this location. The validity of monitoring all four in each monitoring round can be kept under review.

140a. The Agency has taken the proposals in the APs' RS as a guide to the changes in monitoring the APs would like to see. This should not be taken as any agreement by the Agency to the RS proposals as a whole (see comments on voluntary remediation at paragraphs 85a to 86, above). Paragraphs 140b to 144 below explain the Agency's decisions on monitoring actions 9 and 10 following the consultation.

140b. The APs only propose to monitor MJCA BH3, which shows the lowest contaminant concentrations. The Agency wants them to monitor all boreholes.

140c. The APs omit analyses of chloride, sodium and Total Oxidised Nitrogen. These were included in the First Notice as useful reference parameters. For example, spikes in bromide could be unrelated to the contaminant plumes but result from road salt and chloride and sodium would also be expected to increase if the cause was road salt. Chloride and sodium are therefore retained. However the Agency agrees that Total

Oxidised Nitrogen can be dropped. It had been thought that nitrate might mirror bromate and both be reduced by oxygen loss but there is no correlation in the existing monitoring data.

140d. Affinity (Annex B_Affinity, paragraph 16.18) want all major ions to be monitored so that ionic balance can be calculated. They also mention other determinands which would assist in better defining flow mechanisms. Whilst of interest, the proposed additional determinands are of limited usefulness and are not directly related to bromate and bromide. Therefore the Agency does not consider these additions to be reasonable.

141. Hatfield Quarry WM7 and WM10 in Table 1 are additional to the monitoring locations in the First Notice and are to improve characterisation of the plumes in the Hatfield Quarry area. The Agency notes that the APs have included these in their list of monitoring sites.

142. In relation to action 9b, the principal British Standard for water quality monitoring is BS EN 5667 *Water quality. Sampling,* especially BS ISO 5667-11:2009, BS 6068-6.11:2009. *Water quality. Sampling. Guidance on sampling of groundwaters*, and BS EN ISO 5667-6:2016. *Water quality. Sampling. Guidance on sampling of rivers and streams* https://doi.org/10.3403/BSENISO5667

142a. The APs suggest that precision, bias and limit of detection be included in the Method Statement to be approved. The Agency agrees that this is sensible as it is more flexible. For example, analytical methods may change and this approach will allow for improvements to be made more easily. The wording of action 9b has been changed accordingly and the relevant table which was Table 3 in the CD has been removed.

142b. The practicality of a six week period for monitoring results to be reported after sampling is accepted and the wording at action 9d now reflects this. A similar change has been made to action 10a below.

143. This action is similar to Assessment Action G of the First Notice but the duration is not limited to five years.

S.10 Groundwater and surface water monitoring of the bromate plume

10. A Monitoring Action must be undertaken as below:

a. Provide quality-assured monitoring data and report it to the Agency quarterly within six weeks of sampling in January, April, July and October at the locations identified in Table 3 below for the parameters, and at the frequencies, in Table 2 above and to the detection limits, precision and bias specified in the approved method statement referred to in action 9b above, unless otherwise agreed in writing with the Agency.

b. Procedures for sampling, sample handling and sample analysis are to be as specified for Action 9 above.

Table 3. Locations to be monitored under Monitoring Action 10

Location reference	***Site name***	***Type[1]***	***NGR****
020	*Cap's Cottages*	*P*	*TL 18400 09900*
018	*Fairfolds Farm*	*P*	*TL 18800 10100*
059	*Hatfield Quarry, WM1*	*M*	*TL 18800 08395*
375	*Symonshyde Quarry, W29*	*M*	*TL 2129010670*
378	*Symonshyde Quarry, W35*	*M*	*TL 20370 10445*
379	*Symonshyde Quarry, W36*	*M*	*TL 21100 10500*
167	*The Old Cottage, new bh*	*P*	*TL 21900 10700*
191	*M7, Mill Green Borehole*	*M*	*TL 23716 09780*
005	*Hatfield and London Country Club Workshop*	*P*	*TL 28200 08500*
265	*Park Street, Old Hatfield*	*M*	*TL 23410 08778*
195	*M10, Sleapshyde OBH*	*M*	*TL 20251 06887*
010b	*BH by Block 3 Glinwell's Nursery*	*P*	*TL 19500 07400*
041	*Ellenbrook @ North Orbital Road (A414)*	*S*	*TL 20882 07164*
292	*R Lee, Water Hall gauging station*	*S*	*TL 29967 09978*
101	*River Lee downstream from Essendon Pumping Station (Holwell Bridge)*	*S*	*TL 27641 09814*
142	*Roestock P.S. (raw water sampling point)*	*PWS*	*TL 21000 05900*
141	*Tyttenhanger P.S. (raw water sampling point*	*PWS*	*TL 19800 05700*
143	*Essendon P.S. (raw water sampling point)*	*PWS*	*TL 27300 09800*
144	*Waterhall P.S. (raw water sampling point)*	*PWS*	*TL 29400 09500*
298	*Broadmeads PWS*	*PWS*	*TL 35300 13900*
295	*Amwell End PWS*	*PWS*	*TL 35800 13900*
296	*Amwell Hill PWS*	*PWS*	*TL 36700 12700*
297	*Amwell Marsh PWS*	*PWS*	*TL 37600 12300*
301	*Rye Common PWS*	*PWS*	*TL 37900 11100*
MR	*Middlefield Road PWS*	*PWS*	*TL 37400 09500*
300	*Hoddesdon PWS*	*PWS*	*TL 37800 08900*
299	*Broxbourne PWS*	*PWS*	*TL 37300 07500*
302	*Turnford PWS*	*PWS*	*TL 36000 04400*

Notes to Table 3:
**Precise locations of abstractions are masked*
[1]M – monitoring borehole, P – private water supply, PWS – public water supply, S – surface water

This action must be started within three months of the date of this notice and continued for ten years, or such shorter period as may be agreed in writing by the Agency.

144. Locations: Suttons Farm W23, W24 and Holly Cottage were proposed in the CD as additional locations to those in the First Notice and were to improve characterisation of the bromate plume. The Agency notes that the APs have not included these monitoring points in their Table 3 of the RS but there is no explanation given. In the interests of keeping costs down, the Agency has removed these monitoring points from the Second Notice. The Agency's recent sampling at Holly Cottage to assess monitoring viability revealed

deterioration of the headworks and an iron-rich water which may lead to it being an unreliable monitoring point.

145. The Monitoring Action is necessary for the same reasons as given for Action 9. Monitoring Assessment and is similar to Assessment Action H of the First Notice but the duration is not limited to five years.

S.11 Continuation of scavenge pumping at Bishop's Rise

11. A Remedial Treatment Action must be undertaken in accordance with the requirements set out below unless varied in writing by the Agency:

a. Continue to procure the existing scavenge pumping and treatment programme being carried out from the Affinity Water existing abstraction boreholes at Bishops Rise, Hatfield (Bishops Rise). For the purposes of this action the material features of the existing scavenge pumping and treatment programme are as follows:

(i) Maintaining abstraction from Bishops Rise source. Actual abstraction rates are maximised on a day by day basis, taking into account constraints imposed by the treatment process, operational considerations and the capacity of the receiving sewer system. Rainfall events have an impact on the attainable flows. Maximum rates of abstraction are 9 Ml/d (the licensed amount), with an average annual daily target of 6 Ml/d.

(ii) Dosing the abstracted water with ferrous chloride or an alternative suitable reducing agent of reasonable cost to reduce bromate in the water to bromide, if required.

(iii) Using a dedicated pipeline to remove the abstracted water to a trunk sewer system managed by Thames Water Utilities Ltd.

(iv) Monitoring water levels in the receiving sewer manhole and ensure that the discharge has no detrimental impacts on the sewer network.

b. Continue to procure monitoring, or carry out monitoring in agreement with the Water Companies, as follows:

(i) Monitoring at the locations and frequencies in Table 4 below for the parameters in Table 2 above and to the detection limits, precision and bias set out in the Method Statement specified in Action 9b above, unless otherwise agreed in writing by the Agency.

(ii) Monitoring of bromate and bromide weekly, or at such other frequency as may be agreed in writing by the Agency, in the final effluent at the receiving sewage treatment works, Blackbirds and Maple Lodge.

(iii) Reporting of the results of monitoring, under 11a(iv) to 11b(ii) above, to the Agency and in accordance with a scheme of reporting that has been agreed in writing by the Agency.

c. In connection with this action the following definitions shall apply:

(i) "procure" shall mean payment quarterly in arrears as follows:

1. *To Affinity Water, all the costs solely attributable to pumping and treatment of bromate-contaminated groundwater, and associated costs of monitoring (at the locations and frequencies designated for Affinity Water in Table 5 below) and management.*
2. *To Thames Water Utilities Ltd, all costs solely attributable to disposal of the treated groundwater by foul sewer and associated costs of monitoring (at the locations and frequencies designated for Thames Water Utilities Ltd in Table 5 below) and management.*

(ii) *"Water Companies" shall mean Affinity Water and Thames Water Utilities Ltd or any successor(s) to their respective water undertakings.*

(iii) *"Required Concentration Standards" shall (other than those relating to sewage effluent, and unless otherwise agreed by the Agency) mean, in relation to each location in Table 4 below:*
1. *For bromate less than or equal to 5 µg/l.*
2. *For bromide less than or equal to 500 µg/l.*

(iv) *"Relevant Abstraction Points" shall mean the public water supply sources and associated monitoring points, other than those relating to sewage effluent, listed in Table 4 below.*

d. *This action must be commenced from the date of this notice. It must be continued for the period defined by whichever is the shortest of (i) or (ii) or (iii) below:*

(i) *Until an alternative Remedial Treatment scheme has been approved by the Agency, implemented and shown to be effective in controlling concentrations of bromate at the Relevant Abstraction Points without any associated adverse environmental consequences;*

(ii) *Until the Appropriate Person(s) demonstrate that the Required Concentration Standards have been achieved and can be maintained in the raw water abstracted from all the Relevant Abstraction Points, with the exception of Bishops Rise, without the continuation of such pumping at Bishops Rise;*

(iii) *Ten years, or such shorter period as may be agreed in writing by the Agency.*

Table 4. Locations to be monitored in connection with Remedial Treatment Action 11

Location reference	***Site name***	***Type[1]***	***NGR***	***Designation[1] in relation to payments for monitoring***	***Frequency***
143	*Essendon PWS*	*PWS*	*TL 27300 09800*	*Affinity*	*Weekly*
001	*Bishops Rise PWS*	*PWS*	*TL 22000 07700*	*Affinity*	*Weekly*
298	*Broadmeads PWS*	*PWS*	*TL 35300 13900*	*TWUL*	*Fortnightly*
295	*Amwell End PWS*	*PWS*	*TL 35800 13900*	*TWUL*	*Fortnightly*
296	*Amwell Hill PWS*	*PWS*	*TL 36700 12700*	*TWUL*	*Fortnightly*
297	*Amwell Marsh PWS*	*PWS*	*TL 37600 12300*	*TWUL*	*Fortnightly*
301	*Rye Common PWS*	*PWS*	*TL 37900 11100*	*TWUL*	*Fortnightly*
MR	*Middlefield Road PWS*	*PWS*	*TL 37400 09500*	*TWUL*	*Fortnightly*
300	*Hoddesdon PWS*	*PWS*	*TL 37800 08900*	*TWUL*	*Fortnightly*
299	*Broxbourne PWS*	*PWS*	*TL 37300 07500*	*TWUL*	*Fortnightly*
302	*Turnford PWS*	*PWS*	*TL 36000 04400*	*TWUL*	*Fortnightly*
103	*Chadwell Spring*	*S*	*TL 34997 13683*	*TWUL*	*Fortnightly*
382	*Lynch Mill Spring*	*S*	*TL 37711 08519*	*TWUL*	*Monthly*
288	*Stream from Arkley Hole spring, upstream of confluence with Lee*	*S*	*TL 28976 10021*	*Affinity*	*Monthly*
GB	*River Colne at Green Bridge*	*S*		*Affinity*	*Monthly*
ML	*Maple Lodge sewage treatment works final effluent*	*E*		*TWUL*	*Weekly*
BB	*Blackbirds sewage treatment works final effluent*	*E*		*TWUL*	*Weekly*
S = surface water, PWS = public water supply, E = sewage effluent					

Note to Table 4:

[1]Affinity - Affinity Water, TWUL - Thames Water Utilities Ltd

146. This Remedial Treatment Action ensures continuation of scavenge pumping as an interim measure to manage the plume down gradient of Bishop's Rise. This has been shown to be effective in reducing bromate concentrations at down gradient public water supplies by hydraulic containment and to remove some contaminant from the groundwater as well. The Agency has no reason to believe it will not remain as part of the long term remediation once appropriate additional measures have been identified.

146a. In their consultation response (Annex C_Others), Hertfordshire County Council recommends the addition of a further borehole for monitoring purposes. We agree that a monitoring point near to the Bishop's Rise scavenging location would generally be good practice. However, in this case, we consider it would be of little value since the scavenging borehole has a number of adits and well-developed fissures in the vicinity. This heterogeneity in the Chalk means that a monitoring borehole is unlikely to be representative. We therefore do not propose to carry forward this recommendation at this time.

146b. At paragraph 3.2 of the RS the APs suggest that they will be doing the monitoring. There is merit in this suggestion but in the Agency's experience, TWUL will not allow others to sample from their supplies. We have therefore introduced flexibility by changing the wording to *monitor or procure the monitoring.*

147. In order to address the practical difficulty of iron precipitation blocking the discharge main, a one month dosing trial started on 20th August 2018. The objective of the trial was to assess the effect on sewage effluent quality of a reduced dosing rate with the ferrous dose brought down to 10mg/l, and flow at 4Ml/d. A staged increase in abstraction at the reduced dose rate started in mid-September. The scavenging remedial action includes the wording "if required" to allow for the possibility that no dosing is required.

148. As a result of the dosing trial, ferrous chloride dosing has been reduced to 10mg/l. One of the recommendations in the report (see paragraph 77) of the trial was that the dose could be investigated further in a separate trial to determine the level of bromate reduction in the Bishops Rise discharge main at different dose rates.

148a. The trial also led to some other recommendations which could allow an increase in abstraction rates, namely:

- Determine the driver for setting the automated shutdown cut off at 40% for the sewer level including assessing the risk of sewer flooding downstream and previous concerns of flooding near the bowls club adjacent to the College Lane sewer.
- Investigate the causes of the various shut downs during the trial, including reviewing the sewer level trigger and pump cut out level. Also review the pump depth relative to the top of the adit via CCTV inspection, if possible.

148b. Where practicable, effective and durable, infrastructure and/or other changes are to be procured or implemented to meet the requirement in 11a(i) for an average annual daily target of 6Ml/day. The APs must work with the Water Companies to achieve this. Sub-action 8a(iv) has been added to provide an assessment action for this. The change from the CD draws on the APs' suggestions in the RS although the Agency does not agree with the context in which these ideas are presented.

148c. In relation to 11a(vi), TWUL have requested weekly influent monitoring as well as effluent monitoring (Annex A_Thames, paragraph F.3.) to ensure that the influences on the concentrations in the effluent discharging to the River Colne are understood. TWUL explain that in practice, this is already carried out as part of the current monitoring programme, with the data provided to the Agency and the Appropriate Persons. The APs do not consider it necessary to formally include monitoring of the inflows in a subsequent notice and at this time. The Agency agree.

148d. In relation to 11b(i) The method statement is the APs' but the Agency accept the Water Companies' standard procedures in relation to detection limits, precision and bias.

149. The RCS remain unchanged. One of the time limits for this action is compliance with the RCS (see Assessment Action 11 c(ii) above). The Inspector acknowledged that there is no specific drinking water standard for bromide but that it is the indirect effect of bromide which is the concern.

> IR38 *There is no prescribed limit for bromide, but it is a requirement drinking water must not contain any substance at a concentration which by itself, or in conjunction with any other substance, would constitute a potential danger for health. When water is treated for drinking, bromide can sometimes be converted to bromate and/or brominated trihalomethanes (THMs). Bromide is also considered harmful to health if consumed at high concentrations; consultants advising the EA have suggested that a limit of 3000 µg/l in drinking water might be appropriate, based on an acceptable daily intake identified by the (1966) Joint FAO/WHO Meeting on Pesticide Residues. Average concentrations in a private supply (Nashes Farm) close to SLC exceed this guideline figure*

149a. The Agency has no objection to the APs' proposal at paragraph 3.3(c) of the RS and referred to by them at I.1 of Annex A_Thames to undertake an assessment of the appropriate revision of the RCS. The wording: *unless otherwise agreed* in Action 11b(iii) allows for the APs to propose alternative RCS, although the Agency considers agreement to a change is unlikely at this time. We do not support the linked proposal in the RS which is to assess the ongoing need for scavenge pumping at Bishop's Rise, at this time. See paragraphs 85a to 86 for the Agency's overview comments on the RS.

150. The wholesomeness requirement remains unchanged in the current regulations at Reg.4(2)(c) Water Regulations.

151. Since the Inspector's report, the World Health Organisation (WHO) has published a document on bromide levels in drinking water, *Guidelines for Drinking-water. Fourth_Edition_Bromide_Final_January_2010* *http://www.who.int/water_sanitation_health/dwq/chemicals/Fourth_Edition_Bromide_Final_January_2010.pdf* stating:

> *Assuming a relative source contribution of 50%, the drinking-water value for a 60 kg adult consuming 2 litres/day would be up to 6 mg/l; for a 10 kg child consuming 1 litre/day, the value would be up to 2 mg/l. However, the dietary bromide contribution for a 10 kg child would probably be less than that for an adult. These are reasonably conservative values, and they are unlikely to be encountered in drinking-water supplies*.

A conservative acceptable level for bromide in drinking water therefore decreases from the 3000 µg/l (3 mg/l) quoted previously to 2000 µg/l (2 mg/l) to allow for consumption of the water by a child, assuming water treatment effects (referred to in IR38) do not apply. Bromide concentrations therefore remain important, if not more so.

151a. In line with the APs additional analysis of the cost effectiveness, of the Bishop's Rise scavenge pumping, as explained in Annex C_Crest, paragraphs 65-68, and the value in reducing contaminant concentrations further down gradient, we believe this should no longer be just an interim measure but becomes an integral part of any remediation package.

151b. A change to long-term status for this action is also in line with TWUL's consultation response at B.1 and, as they themselves remark, transitional arrangements may not then be required. Any change in the status of the Bishop's Rise scavenge pumping will now be left until a third remediation notice unless, of course, other arrangements are proposed and agreed in writing. 11c(i) allows for changes to be agreed in writing. These could be large changes or quite small changes to the current action such as some or all of the discharge no longer going to sewer. Any changes will need to be approved by the Agency and this includes the transitional arrangements referred to by TWUL.

151c. Affinity question the additional time limits to that of meeting the RCS ten year time limit at 11d (11c in the CD) at Annex B_Affinity, paragraph 16.25. The Inspector at IR877 regarded this as a reasonable timescale for the First Notice and the Agency sees no reason to change this. A ten year period has the additional advantage of being consistent with the normal licence abstraction renewal period.

152. The beneficial effect of scavenge pumping at Bishop's Rise is described under the heading: *O.2 The evidence for contaminant migration* (paragraphs 64 to 67) and the importance of this is covered in the Section *N. The need for subsequent Remediation Notices* (paragraphs 53 to 60).

153. Report F1 9.14 states:

> *If the constraints relating to the treatment options which could return the water to a quality suitable for public use cannot be overcome in practice or within reasonable conditions, the next preferred option is to discharge the abstracted water to the sewer as is the case currently.*

154. The Agency sees no need to change the wording for the Remedial Treatment Action from that in Action I of the First Notice other than minor updating, wording related to dosing as at 11a(ii) above and that the action must commence at the start of the Second Notice.

155. In the CD monitoring frequencies were as set in the First Notice but we sought views on the frequency of monitoring now that more than 9 years of data have been collected. TWUL suggest at Annex C_Thames paragraph F.2, and the APs agree, to a change to fortnightly monitoring at the NNR wells and Chadwell Spring. The Agency agrees.

S.12 Annual Reports

12. An Assessment Action must be undertaken as below:

Provide annual progress reports to the Agency in writing to include reviews of:

(i) the effectiveness of remediation;
(ii) the evolution of the plumes; and
(iii) the need for further active measures.

This action must be completed within 14 months of the date of this notice and every 12 months thereafter, unless otherwise agreed in writing with the Agency.

156. This will update the Agency on the effectiveness of remediation, evolution of the plumes and the need for further active measures but is not designed to preclude more regular communication. Report F1, 8.24 supports such an approach:

> *8.24 During and following the final assessment and selection of the optimum combination of remediation and treatment techniques, it will be necessary to continue to carry out monitoring of groundwater and surface water quality to assess the progress of the remediation activity and the evolution of the contaminant plume. Regular reviews of the effectiveness of remediation, the evolution of the plume and the need for further active measures will need to be carried out.*

157. The timing is such that actions 1 to 6 will have been completed by the first report and therefore the annual reports will provide progress on actions 7 to 11.

157a. TWUL (Annex C_Thames, D.2) are correct in that a third remediation notice (or voluntary alternative) will be needed to implement new remedial treatment options.

T. Description of the Remediation Notice and Schedules

158. The structure of the Second Notice is similar to the First Notice but additionally includes two notes to recipients for information which do not form part of the Notice. The second of these allows the APs to request an independent internal review of our decision to issue the notice. See:
https://www.gov.uk/government/organisations/environment-agency/about/complaints-procedure
Asking us to review our decision will not affect the time limits within which any statutory appeal must be made and we expect any request to review this regulatory decision to be made within 14 days.

Schedule 1 describes the location and extent of the contaminated land known as SLCourt.

Schedule 2 contains the assessment actions and remedial treatment action as described in Section S above.

Schedule 3 gives the particulars of the contaminant linkages.

Schedule 4 explains the use of assessment actions and the urgent interim remedial treatment action and that further remedial treatment actions will be included in one or more subsequent remediation notices unless voluntary remediation can be agreed.

Schedule 5 explains who the APs are and why they are responsible for the actions in Schedule 2. It also provides details of the apportionment between the APs.

Schedule 6 gives the names and addresses of landowners affected by the Second Notice. These are the statutory consultees and the list has been appropriately redacted.

Schedule 7 describes the associated offences, penalties, right of appeal and appeal procedures to be followed.

TABLES

Table A – List of consultee responses

DD reference	Agency response identification	Date	Consultee	Consultee status	How
(see Appendix 3)	ANON-BWF1-MQKS-C	2019-01-12	Individual	Non-statutory	Online consultation portal and email
(see Appendix 3)	ANON-BWF1-MQKC-V	2019-02-21	Sandridge Parish Council	Non-statutory	Online consultation portal
(see Appendix 3)	ANON-BWF1-MQKJ-3	2019-03-06	Individual	Non-statutory	Online consultation portal
(see Appendix 3)	ANON-BWF1-MQKP-9	2019-03-06	Margaret Eames-Petersen (Member of local government and Hertfordshire County Councillor)	Non-statutory	Online consultation portal
(see Appendix 3)	BHLF-BWF1-MQKW-G	2019-03-07	Public Health England	Non-statutory	Email
(see Appendix 3)	BHLF-BWF1-MQKH-1	2019-03-07	Hertfordshire County Council Public Health service	Non-statutory	Email
(see Appendix 3)	BHLF-BWF1-MQK2-B	2019-03-07	St Albans City and District Council	Statutory	Email
(see Appendix 3)	BHLF-BWF1-MQKG-Z	2019-03-07	Welwyn Hatfield Borough Council	Statutory	Email
(see Appendix 3)	CR HCC RE	2019-03-15	Hertfordshire County Council's Rural Estates department	Statutory	Email
TWUL	SS/maj	2019-03-29	TWUL	Statutory	Email and hard copy
(see Appendix 3)	CR CEMEX	2019-03-29	CEMEX	Statutory	Email
APs' overarching response	PPE-#28194810-v3 (overarching response)	2019-03-29	Redland Minerals Limited and Crest Nicholson Residential Limited	Statutory (Appropriate Persons)	Email and hard copy
Annex A_Crest	TAR_SANg23708 (Annex A. Main document)	2019-03-29	Redland Minerals Limited and Crest Nicholson Residential Limited	Statutory (Appropriate Persons)	Email and hard copy

DD reference	Agency response identification	Date	Consultee	Consultee status	How
Annex B_Crest	TAR_SANg23708 (Annex B. Detailed response to Appendix 2)	2019-03-29	Redland Minerals Limited and Crest Nicholson Residential Limited	Statutory (Appropriate Persons)	Email and hard copy
Annex C_Crest	TAR_SANg23708 (Annex C. Supporting Technical Details)	2019-03-29	Redland Minerals Limited and Crest Nicholson Residential Limited	Statutory (Appropriate Persons)	Email and hard copy
RS	PPE-#28194490-v2 (proposed voluntary agreement/ Remediation Notice)	2019-03-29	Redland Minerals Limited and Crest Nicholson Residential Limited	Statutory (Appropriate Persons)	Email and hard copy
D'Arblay	P000051 / 21728	2019-03-29	Bidwells on behalf of D'Arblay Investments	Statutory	Email
Affinity	CR Affinity	2019-03-31	Affinity	Statutory	Email
Affinity_Further	FCR Affinity	2019-04-29	Affinity	Statutory	Email
(not specifically mentioned in DD)	PPE-#28223286-v2 (overarching comments on consultation responses)	2019-05-01	Redland Minerals Limited and Crest Nicholson Residential Limited	Statutory (Appropriate Persons)	Email and hard copy
Annex A_Thames	TAR_SANg23855Annex A – Thames	2019-05-01	Redland Minerals Limited and Crest Nicholson Residential Limited	Statutory (Appropriate Persons)	Email and hard copy
Annex B_Affinity	TAR_SANg23855Annex B – Affinity	2019-05-01	Redland Minerals Limited and Crest Nicholson Residential Limited	Statutory (Appropriate Persons)	Email and hard copy
Annex C_Others	TAR_SANg23855Annex C – Others	2019-05-01	Redland Minerals Limited and Crest Nicholson Residential Limited	Statutory (Appropriate Persons)	Email and hard copy

Table B – Summary of monitoring locations in the Second Notice

Location reference	Site name	Second Notice Action	Type of monitoring location[1]	Installed for SLCourt[2]	5yr mean BrO_3 (µg/l) 01/2013-01/2018[3,4]	5yr mean Br (µg/l) 01/2013-01/2018[3,4]
295	Amwell End PWS	10 and 11	public water supply	existing	1.50	66.73
296	Amwell Hill PWS	10 and 11	public water supply	existing	16.16	139.68
297	Amwell Marsh PWS	10 and 11	public water supply	existing	15.70	139.04
010b	BH by Block 3 (Northernmost) Glinwells Nursery	10	private water supply	existing	1.00	68.57
001	Bishops Rise PWS	9 and 11	public water supply	existing	312.35	741.62
BB	Blackbirds sewage treatment works final effluent	11	sewage effluent	n/a	3.25	214.34
080	Borehole No. 2, St Leonard's Court	9	monitoring borehole	installed for SLCourt	1.00	256,260.00
081	Borehole No. 3, St Leonard's Court	9	monitoring borehole	installed for SLCourt	20.14	47,211.00
082	Borehole No. 4, St Leonard's Court	9	monitoring borehole	installed for SLCourt	155.08	1,641.40
083	Borehole No. 5, St Leonard's Court	9	monitoring borehole	installed for SLCourt	6.16	2,211.10
298	Broadmeads PWS	10 and 11	public water supply	existing	0.35	80.88
299	Broxbourne PWS	10 and 11	public water supply	existing	21.42	161.89
002	Business Park	9	private water supply	existing	602.72	1,124.74
020	Cap's Cottage	10	private water supply	existing	37.46	101.19
103	Chadwell Spring	11	surface water	n/a	3.17	105.30

Location reference	Site name	Second Notice Action	Type of monitoring location[1]	Installed for SLCourt[2]	5yr mean BrO_3 (µg/l) 01/2013-01/2018[3,4]	5yr mean Br (µg/l) 01/2013-01/2018[3,4]
402	Comet Way, BH5	9	monitoring borehole	existing	687.95	1,327.50
041	Ellenbrook at North Orbital Road A414	10	surface water	n/a	7.25	165.42
143	Essendon P.S. (raw water sampling point)	10 and 11	public water supply	existing	26.35	140.60
018	Fairfolds Farm	10	private water supply	existing	2.39	54.45
223	GW10, St Leonard's Court	9	monitoring borehole	installed for SLCourt	2,125.65	3,960.50
225	GW12 Top of House Lane	9	monitoring borehole	installed for SLCourt	1.00	970.55
226	GW13, Harefield House	9	monitoring borehole	installed for SLCourt	879.80	1,813.00
227	GW14, beside Jersey Farm pond	9	monitoring borehole	installed for SLCourt	1.00	281.50
216	GW3, St Leonard's Court	9	monitoring borehole	installed for SLCourt	2,442.96	2,465.65
005	Hatfield London Country Club, Workshop	10	private water supply	existing	5.33	92.81
059	Hatfield Quarry, WM1	10	monitoring borehole	existing	2.20	70.27
066	Hatfield Quarry, WM10, lower level (P2)	9	monitoring borehole	existing		
162	Hatfield Quarry, WM3B	9	monitoring borehole	existing	1.00	556.30
061	Hatfield Quarry, WM4	9	monitoring borehole	existing	51.44	1,132.30
062	Hatfield Quarry, WM5	9	monitoring borehole	existing	772.50	1,565.00
064	Hatfield Quarry, WM7	9	monitoring borehole	existing		
166	Hatfield Quarry, WPG16	9	monitoring borehole	installed for SLCourt	956.92	1,698.66

Location reference	Site name	Second Notice Action	Type of monitoring location[1]	Installed for SLCourt[2]	5yr mean BrO_3 (µg/l) 01/2013-01/2018[3,4]	5yr mean Br (µg/l) 01/2013-01/2018[3,4]
300	Hoddesdon PWS	10 and 11	public water supply	existing	28.82	169.43
382	Lynch Mill spring	11	surface water	n/a	27.64	148.81
195	M10, Sleapshyde OBH	10	monitoring borehole	installed for SLCourt	1.00	106.92
191	M7, Mill Green Borehole	10	monitoring borehole	installed for SLCourt	7.37	96.17
ML	Maple Lodge sewage treatment works final effluent	11	sewage effluent	n/a	0.88	165.71
MR	Middlefield Road PWS	10 and 11	public water supply	existing	25.88	162.88
019	Nashes Farm	9	private water supply	existing	537.67	1,259.15
028	Orchard Garage	9	private water supply	existing	314.45	655.25
028b	Orchard Garage MJCA BH1	9	monitoring borehole	installed for SLCourt		
028c	Orchard Garage MJCA BH2	9	monitoring borehole	installed for SLCourt		
028d	Orchard Garage MJCA BH3	9	monitoring borehole	installed for SLCourt		
265	Park Street	10	monitoring borehole	installed for SLCourt	46.47	130.07
GB	River Colne (Green Bridge)	11	surface water	n/a	0.05	83.87
101	River Lee downstream from Essendon Pumping Station, Holwell Bridge	10	surface water	n/a	11.80	93.94
142	Roestock P.S. (raw water sampling point)	10	public water supply	existing	0.00	134.75
301	Rye Common PWS	10 and 11	public water supply	existing	16.86	136.51

Location reference	Site name	Second Notice Action	Type of monitoring location[1]	Installed for SLCourt[2]	5yr mean BrO_3 (µg/l) 01/2013-01/2018[3,4]	5yr mean Br (µg/l) 01/2013-01/2018[3,4]
288	Stream from Arkley Spring, us confluence with river Lee	11	surface water	n/a	20.65	148.21
375	Symondshyde Farm W29 (Hatfield Quarry)	10	monitoring borehole	existing	2.41	54.86
378	Symondshyde Farm W35 (Hatfield Quarry)	10	monitoring borehole	existing	95.82	214.00
379	Symondshyde Farm W36 (Hatfield Quarry)	10	monitoring borehole	existing	53.19	136.70
167	The Old Cottage, new bh	10	private water supply	existing	1.00	66.23
302	Turnford PWS	10 and 11	public water supply	existing	13.92	141.27
141	Tyttenhanger P.S. (raw water sampling point)	10	public water supply	existing	0.00	340.82
292	Water Hall gauging station	10	surface water	n/a	3.72	101.34
144	Waterhall P.S. (raw water sampling point)	10	public water supply	existing	0.02	78.87

Notes to Table B:

[1] Type of monitoring location as presented in Second Notice Tables 1, 3 and 4.

[2] 'Installed for SLCourt' indicates that boreholes were drilled to investigate the bromate and bromide groundwater pollution.

[3] Concentrations are from monitoring results provided by the APs that are averaged over 5 years (January 2013 – December 2017, inclusive). See paragraph 8 of Appendix 2.

[4] Cells for the locations that are additional to the First Notice are grey since they were not regularly sampled during the 5 year period.

Table C – Actions of the First Notice compared with Second Notice

First Notice (served 22 July 2009)						Second Notice (served July 2019)					
Action	**Brief description**	**Deadline SoS date[1]**	**Significant Pollutant Linkage**	**Type**	**Apportionment**	**Action**	**Brief description**	**Deadline**	**Significant Contaminant Linkage**	**Type**	**Apportionment**
A Assessment	Estimate contaminant loads at SLCourt.	Nov 2009	Bromate and bromide	Shared Common	65% Redland 35% Crest						
B Assessment	Estimate contaminant flux from SLCourt.	Nov 2009	Bromate and bromide	Shared Common	65% Redland 35% Crest						
C Assessment	Review groundwater modelling.	Jan 2010	Bromate and bromide	Shared Collective	72% Redland 28% Crest						
						1 Assessment	Assess the feasibility of treating the contaminated groundwater for raw water supply or similar quality standard using: (A) Granular Activated Carbon, (B) Ion Exchange, (C) Combinations of treatments.	Nov 2019	Bromate	Single Linkage	85% Redland 15% Crest
						2 Assessment	Assess locations in the vicinity of Bishop's Rise and up gradient for a treatment plant with connection to raw water supply network and/or means of disposal.	Nov 2019	Bromate	Single Linkage	85% Redland 15% Crest
						3 Assessment	Identify the best practicable technique using 1 and 2 above and provide the reasons.	Jun 2020	Bromate	Single Linkage	85% Redland 15% Crest

First Notice (served 22 July 2009)						Second Notice (served July 2019)					
Action	**Brief description**	**Deadline SoS date[1]**	**Significant Pollutant Linkage**	**Type**	**Apportionment**	**Action**	**Brief description**	**Deadline**	**Significant Contaminant Linkage**	**Type**	**Apportionment**
D Assessment	Identify locations for scavenge pumping closer to SLCourt.	Nov 2009	Bromate and bromide	Shared Common	65% Redland 35% Crest	4 Assessment	Assess scavenge pumping at the specified locations up gradient of Bishop's Rise.	Nov 2019	Bromate and bromide	Shared Common	65% Redland 35% Crest
D1 Assessment	Estimate costs for pump and treat at each location.	Nov 2009	Bromate	Single Linkage	85% Redland 15% Crest	5A Assessment	Estimate costs of scavenge pumping, treatment and discharge from the specified locations up gradient of Bishop's Rise. <u>Treatment.</u> Bromate reduction to bromide (if required)	Nov 2019	Bromate	Single Linkage	85% Redland 15% Crest
						5B Assessment	<u>Treatment</u>. Bromate and bromide removal	Nov 2019	Bromate and bromide	Shared Common	65% Redland 35% Crest
D2 Assessment	Estimate costs for discharge and disposal at each location.	Nov 2009	Bromide	Single Linkage	45% Redland 55% Crest	6 Assessment	Estimate costs of disposal of bromide contaminated water from scavenge pumping.	Nov 2019	Bromide	Single Linkage	45% Redland 55% Crest
D3 Assessment	Report on pumping trial.	Proposal: Dec 2009 Report: Mar 2010	Bromate and bromide	Shared Common	65% Redland 35% Crest	7 Assessment	Report on one year's scavenge pumping trial.	Jul 2021[2]	Bromate and bromide	Shared Common	65% Redland 35% Crest
E Assessment	Review alternative remedial options.	Jan 2010									
F1 Assessment	Determine best practicable technique.	Mar 2010	Bromate and bromide	Shared Collective	65% Redland 35% Crest	8 Assessment	Update Report F1 to determine best practicable technique.	Oct 2021[3]	Bromate and bromide	Shared Collective	65% Redland 35% Crest
G Assessment	Groundwater monitoring.	Oct 2014	Bromate and bromide	Shared Common	65% Redland 35% Crest	9 Monitoring	Groundwater monitoring.	Jul 2029	Bromate and bromide	Shared Common	65% Redland 35% Crest

First Notice (served 22 July 2009)						Second Notice (served July 2019)					
Action	**Brief description**	**Deadline SoS date[1]**	**Significant Pollutant Linkage**	**Type**	**Apportionment**	**Action**	**Brief description**	**Deadline**	**Significant Contaminant Linkage**	**Type**	**Apportionment**
H Assessment	Groundwater and surface water monitoring.	Oct 2014	Bromate	Single Linkage	85% Redland 15% Crest	10 Monitoring	Groundwater and surface water monitoring.	Jul 2029	Bromate	Single Linkage	85% Redland 15% Crest
I Remedial Treatment	Scavenge pumping at Hatfield and associated monitoring.	Jul 2019[4]	Bromate	Single Linkage	85% Redland 15% Crest	11 Remedial Treatment	Scavenge pumping at Hatfield and associated monitoring.	Jul 2029[4]	Bromate	Single Linkage	85% Redland 15% Crest
						12 Assessment	Annual Reports.	Jul 2020-Jul 2029	Bromate and bromide	Shared Collective	65% Redland 35% Crest

Notes to Table C:

[1] date informally extended following formal determination of the judicial review proceedings

[2] proposal submitted 1 month after Actions 4, 5, 6 completed, trial undertaken 3 months from EA approving proposal and report submitted 3 months after trial (assuming approved same month as submitted).

[3] 4 months after Action 7 completed.

[4] the earlier of: implementing a better remediation technique, natural abatement of plume, or 10 years.

APPENDICES

APPENDIX 1
FIRST NOTICE

ENVIRONMENTAL PROTECTION ACT 1990, SECTION 78E(1)

THE CONTAMINATED LAND (ENGLAND) REGULATIONS 2000 (SI 2000 NO: 227)

THE CONTAMINATED LAND (ENGLAND) (AMENDMENT) REGULATIONS 2001 (SI 2001 NO: 663)

REMEDIATION NOTICE – St. Leonard's Court

TO:

1. Redland Minerals Limited of Granite House, Granite Way, Syston, Leicester LE7 1PL
2. Crest Nicholson Residential plc of Crest House, Pycroft Road, Chertsey, Surrey KT16 9GN

This notice is served on you by the Environment Agency ("the Agency") pursuant to s. 78E of the Environmental Protection Act 1990 ("the 1990 Act") in relation to contaminated land identified by St Albans City and District Council under s. 78B EPA and designated as a special site under s. 78C of the 1990 Act.

A notice of identification of contaminated land dated 20th June 2002 was given to you by St Albans City and District Council of St Peter's Street, St Albans, Hertfordshire AL1 3JE in accordance with s. 78B of the 1990 Act that St Leonard's Court, Sandridge ("SLC") is contaminated land.

The location and extent of the contaminated land to which this notice relates is shown edged red on the plan annexed to this notice.

The Environment Agency considers that you are an appropriate person within the meaning of the 1990 Act, by reason of having caused or knowingly permitted the substance, or any of the substances, by reason of which the contaminated land to which this notice relates is contaminated land, to be in, on or under that land.

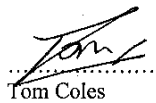
The things that you are required to do by way of remediation and the period within which you are required to do each of these things are set out in Schedule 2.

The further matters required to be stated in this notice are set out in Schedules 3 to 7.

.....
John Collins
Acting North East Area Manager of the Thames Region of the Environment Agency

DATE: 8th November 2005

This notice has been modified by the Secretary of State for Environment, Food and Rural Affairs following appeals made by both parties identified by this notice as appropriate persons.



Tom Coles
Contaminated Land Policy Team, Soils Programme, Defra

DATE: 22nd July 2009

The Environment Agency's address for the purposes of this notice is:

Environment Agency
Kings Meadow House
Kings Meadow Road
Reading
Tel: 0118 953 5175
Fax: 0118 950 9440
Ref: Legal/PC/KM/SLC

The contact name for the purposes of this part of the Notice is Pete Carty

[Note to recipient (this note does not form part of the Notice): Part IIA of the Environmental Protection Act 1990, which was inserted by section 57 of the Environment Act 1995, establishes a framework for the identification and remediation of contaminated land. Part IIA came into force in England on 1st April 2000. Part IIA contains the structure and main provisions of the regime. The Contaminated Land (England) Regulations 2000 (SI 2000/227) and the Contaminated Land (England)(Amendment) Regulations 2001 (SI 2001/663) set out detailed provisions on parts of the regime which Part IIA leaves to be specified in secondary legislation, including provisions relating to Remediation Notices and appeals. DETR Circular 02/2000 contains the statutory guidance which provides the detailed framework for the various key elements of the regime. The DETR Circular also sets out the way in which the regime is expected to work in England, by providing an explanation of government policy (Annex 1), a description of the regime (Annex 2) and a guide to the Regulations (Annex 4). Copies of the DETR Circular can be obtained from The Stationery Office, PO Box 29, Norwich NR3 1GN (www.itsofficial.net)]

SCHEDULE 1

(Location and extent of contaminated land to which this notice relates (Reg 4(1)(b))

The contaminated land is marked by the area edged red shown on the plan annexed hereto and centred on grid reference TL 17086 10460.

SCHEDULE 2

(Remediation requirements and periods (Section 78E(1) of the 1990 Act)

The final Remedial Treatment Actions which will enable the land and controlled waters to be effectively remediated, to the required standards, cannot yet be identified. This is because specific Assessment Actions are needed to characterise in detail the SPLs and to collect data to evaluate the likely effectiveness of Remedial Treatment Actions. Schedule 2 identifies a series of Assessment Actions that will enable Remedial Treatment Actions to be specified in one or more subsequent Remediation Notices. However pollution of controlled waters is continuing. Schedule 2 therefore also includes an interim Remedial Treatment Action which is required to be implemented in a timescale and in a form set out in Schedule 2

Before carrying out the Actions below the Agency shall be informed, in writing, of the person(s) who will do the work, and of their qualifications and experience. The work shall be done only by persons who have been approved by the Agency, in writing, on the basis of such information, such approval not to be unreasonably withheld.

NOTE: Assessment actions A – F1 are desk studies, except for action D3.

A. **An Assessment Action must be undertaken as below.**

(a) Make an estimate using all reasonable endeavours, based on the data available at that time, of the loads of bromate and bromide held in the: (i) made ground: (ii) fluvioglacial deposits; (iii) putty chalk; and (iv) blocky chalk, beneath the area edged red on the plan attached to this Notice, taking account of the data reported in the site investigations carried out by consultants, Komex, in August 2000 and Atkins in November 2001.
(b) Indicate the areas and extent of uncertainty in this estimate and the reasons for this uncertainty.
(c) Design and cost a site investigation to significantly reduce this uncertainty, or demonstrate that such significant reduction cannot reasonably be achieved.
(d) Report the outcome of (a)-(c) above to the Agency in writing.

This action must be completed within four months of the date of this notice.

B. **An Assessment Action must be undertaken as below**

(a) Make an estimate using all reasonable endeavours, based on the data available at that time, of the mass flux of bromate and bromide being transported in groundwater away from the area edged red in the plan attached to this Notice, taking account of the data reported in the site investigations carried out by consultants, Komex, in August 2000 and Atkins in November 2001 and of trials, studies and modelling undertaken on behalf of the Agency and/or the Three Valleys Water plc and/or Thames Water Utilities Ltd.
(b) Indicate the areas and extent of the uncertainty in this estimate and the reasons for this uncertainty.
(c) Design and cost a site investigation to significantly reduce this uncertainty or demonstrate that such significant reduction cannot reasonably be achieved.

(d) Report the outcome of (a)-(c) above to the Agency in writing.

This action must be completed within four months of the date of this notice.

C. An Assessment Action must be undertaken as below.

(a) Review the scope for modelling (i) the bromate plume; (ii) the bromide plume. The review must include:
   (i) Possible types of models;
   (ii) The data requirements of each type;
   (iii) The extent to which the necessary data already exists;
   (iv) The work that would be required to obtain data which does not exist at present;
   (v) The capacity of each type of model to predict how the plume will behave under present conditions and, in particular, how this capacity compares to that of the existing Thames Water Utilities Ltd model, as reported in Atkins, Bromate contamination in the Lee Valley. Phase 2: modelling report, final draft, February 2007.
   (vi) The capacity of each type of model to predict the likely effect on the bromate and bromide plumes of scavenge pumping from different locations and at different rates, the effect of any other action which appears to be a potential Remedial Treatment Action and, in particular, how this capacity compares to that of the existing Thames Water Utilities Ltd model.

(b) Report the outcome to the Agency in writing.

This action must be completed within six months of the date of this notice.

D. **An Assessment Action must be undertaken as below:**

(a) Identify locations at which abstraction of contaminated groundwater from the plume and its subsequent disposal might be undertaken, at St Leonards Court and between St Leonards Court and the borehole of Three Valleys Water at Bishops Rise, Hatfield.
(b) Assess, for each location, options for disposal of the abstracted water by discharge to foul sewer or by other means, and any constraints on the flow rate, overall volume or contaminant loading.
(c) For each location estimate the costs of:
   (i) Acquiring legal rights to carry out the operation at that location;
   (ii) Installing a suitable borehole and pump, or adapting an existing borehole and pump;
   (iii) Providing a pipeline connection to enable disposal of the abstracted water;
   (iv) Recurring annual operating and other costs, excluding any costs related to treatment of the water to reduce bromate to bromide, and the chemical loading element of any trade effluent other charges.
(d) For each location estimate the maximum rate of abstraction that could be achieved within the constraints above, and assess whether this is likely to be the optimal rate to maximise removal of contaminants from the aquifer.
(e) Identify any alternatives to the arrangements outlined in (a)-(d) above that might achieve the same objective of removing contaminants from the aquifer.
(f) Report the outcome of (a)-(e) above to the Agency in writing.

This action must be completed within four months of the date of this notice.

D1. **An Assessment Action must be undertaken as below:**

(a) In relation to action D above for each location estimate the costs of:
  (i) Installing treatment plant to reduce bromate to bromide;
  (ii) Annual operating costs associated with the treatment plant, including any fee for renewal of an associated mobile treatment licence;
  (iii) Annual trade effluent charges relating to discharge of the products of treatment to reduce bromate to bromide.
(b) Report the outcome to the Agency in writing.

This action must be completed within four months of the date of this notice.

D2. **An Assessment Action must be undertaken as below:**

(a) In relation to action D above, for each location estimate the cost of annual charges relating to disposal of bromide-contaminated water to the foul sewer, or by some other means, excluding bromide resulting from the reduction of bromate.
(b) Report the outcome to the Agency in writing.

This action must be completed within four months of the date of this notice.

D3. **An Assessment Action must be undertaken as below:**

(a) At any existing abstraction boreholes identified under action D above and where the owner gives their consent, carry out a three-day pumping trial at the maximum feasible rate consistent with any abstraction licence (or a consent under section 32 of the Water Resources Act 1991, in the absence of an abstraction licence) and the need to dispose of the pumped water without adverse environmental effects.
(b) The trial shall be conducted in accordance with BS ISO 1486:2003 (incorporating Amendment No 1), 'Hydrometric determinations- pumping tests for water wells. Considerations and guidelines for design, performance and use' with the following minimum requirements at each test borehole, unless otherwise agreed in writing by the Agency.
  (i) Before the test obtain and record details of the borehole construction and pump.
  (ii) Identify any existing boreholes within 500m of the test borehole which are suitable for use as observation boreholes.
  (iii) Monitor groundwater levels hourly for three days prior to commencing the test, at the test borehole and any associated observation boreholes.
  (iv) Pump the test borehole at a constant rate of discharge for at least 72 hours, making water level measurement at the test borehole and observation boreholes at the intervals specified in accordance with BS ISO 1486:2003 (incorporating Amendment No 1).
  (v) Take samples of the abstracted water for analysis in accordance with the specification in action G below at the start of the pumping and then at intervals of 15 minutes for the first two hours, 30 minutes for the next two hours, hourly for a further six hours; two-hourly for the following 14 hours, and six hourly thereafter.

(vi) On cessation of pumping measure groundwater levels at the same intervals as in (iv) above until groundwater levels are stable and consistent with those measured before the start of the test. In any event levels are to be measured for at least 72 hours.
(vii) Analyse the test data in accordance with BS ISO 1486:2003.

Proposals for such trials shall be submitted to the Agency in writing, for approval in writing, within one month of the completion of action D above. The trial shall be carried out and reported to the Agency in writing within three months of approval by the Agency under this provision.

E. **An Assessment Action must be undertaken as below.**

(a) Review any additional actions, which each Appropriate Person considers, in relation to the Significant Pollutant Linkage(s) for which it is responsible, could break the pollutant linkage and/or mitigate its effects on groundwater quality. The review must include:
(i) The principle of the action and the way in which it will break the Significant Pollutant Linkage or mitigate effects on groundwater quality;
(ii) The requirements for further information before the action can be fully costed and implemented;
(iii) The range of possible costs;
(iv) The possible timescale for implementing the action;
(v) The potential risks and benefits associated with the action.
(b) Report the outcome to the Agency in writing.

This action must be completed within six months of the date of this notice.

F1. **An Assessment Action must be undertaken as below:**

(a) Using the information gained from actions D, D1, D2, D3 and E above:
(i) Assess the practicality, effectiveness and durability of each option;
(ii) Evaluate including by comparison of the cost benefit analysis for each, which option amounts to the best practicable technique and provide the reasons for that assessment.
(b) Report the outcome to the Agency in writing.

This action must be completed within eight months of the date of this notice or within one month of the completion of the report required under D3, whichever is the later.

G. **An Assessment Action must be undertaken as below.**

(a) Provide quality-assured monitoring data at the locations identified in Table 1 below for the parameters, and at the frequencies, listed in Table 2 below, to the detection limits, precision and bias in Table 3 below, unless otherwise agreed in writing with the Agency.

Table 1. Locations to be monitored under Assessment Action G

Loc ref	Site name	Type	NGR	Ownership
080	MW2, St Leonards Court	M	TL517070 210455	Beechgrove (Sandridge)

				Management Ltd
223	SLC10, St Leonard's Court	M	TL 17134 10440	Beechgrove (Sandridge) Management Ltd
082	MW4, St Leonard's Court	M	TL 17121 10427	Beechgrove (Sandridge) Management Ltd
081	MW3, St Leonards Court	M	TL 17096 10435	Beechgrove (Sandridge) Management Ltd
083	MW5, St Leonards Court	M	TL 17074 10411	Beechgrove (Sandridge) Management Ltd
216	SLC03, St Leonards Court	M	TL 17080 10475	Beechgrove (Sandridge) Management Ltd
028	Orchard Garage	P	TL 17523 10286	Orchard Garage
225	GW12, top of House Lane	M	TL 17152 10365	Hertfordshire County Council
226	GW13, Harefield House	M	TL 17748 10035	Borehole site and access route leased to Agency by Beaufort Trust Corporation Ltd and Lady Mary June Meaney
227	GW14, beside Jersey Farm pond	M	TL 17754 09706	Public access land owned by St Albans District Council
019	Nashes Farm	P	TL 17958 09626	Mr Adrian Sheriff
166	Hatfield Quarry, WPG16	M	TL 20241 09741	Cemex UK
162	Hatfield Quarry WM3B	M	TL 19283 08858	Cemex UK
061	Hatfield Quarry WM4	M	TL 19661 09103	Cemex UK
062	Hatfield Quarry WM5	M	TL 20175 09499	Cemex UK
402	Comet Way BH5	M	TL 521760 208911	Public access
002	Hatfield Business Park	P	TL521350 209795	Arlington
001	Hatfield PWS BH	PWS	TL 22000 07700	Three Valleys Water plc
M = monitoring borehole, P = private water supply, S = surface water, PWS = public water supply				

(b) Methods of borehole purging, sampling, sample handling and analysis are to be detailed in a method statement submitted to the Agency for approval prior to sampling commencing, and are to be in accordance with relevant Agency guidance and practice, including paragraph (c) below, unless otherwise agreed in writing by the Agency.

(c)Analysis of samples is to be carried out by a laboratory accredited to ISO 17025 and using United Kingdom Accreditation Service accredited methods, performance-tested in accordance with Water Research Centre plc (WRc) publication NS30, 'Analytical Quality Control in the Water Industry' (WRc Report NS30, June 1989, ISBN 0902156853). The laboratory will operate a system of routine analytical quality control, preferably based on the use of control charts (see WRc Report Ref: Co4239 'Quality Control Charts in Routine Analysis'). Samples must be analysed within 72 hours of collection.
(d) Results are to be reported to the Agency no more than 4 weeks after sampling or measurement, in a summarised format to be agreed in writing by the Agency, accompanied, where relevant, by laboratory certificates of analysis, which must state the associated measurement uncertainty.

Table 2. Parameters to be measured and frequency of measurement

Controlled waters	Frequency	Monitoring interval	Parameters to be measured (see Table 3 for abbreviations & symbols)
Groundwater in, or in continuity with, the Chalk aquifer	8 times per calendar year*	40-50 days	Water level AOD. Depth to base of borehole where feasible
Groundwater in, or in continuity with, the Chalk aquifer	4 times per calendar year* in January, April, July, & October		pH, EC, Cl, Na, TON, BrO_3, Br, temperature, DO, redox potential

Surface waters	12 times per calendar year*	25-35 days	pH, EC, Cl, Na, TON, BrO_3, Br

NOTE * = or pro-rata per part of calendar year

Table 3. Precision, bias and limit of detection for each quantity measured

Determinand or measurement	Symbol or abbreviation	Limit of detection (See note A)	Precision (See note A)	Bias (See note A)	Comments
Water level above Ordnance Datum	Water level AOD	Not applicable	To nearest 10mm	See note B	Datum points and levels will be supplied. Measurement not feasible at location 028
Depth to base of borehole	None	Not applicable	To nearest 200mm	See note B	Datum points and levels will be supplied. Measurement not feasible in all boreholes.
Temperature	None	Not applicable	To nearest 0.5°C	See note B	Measured in-situ
Dissolved oxygen	DO	Not applicable	See note B	See note B	Measured in-situ
Log hydrogen ion concentration	pH	Not applicable	See note B	See note B	Measured in-situ
Electrical conductivity	EC	Not applicable	See note B	See note B	Measured in-situ
Redox potential		Not applicable	See note B	See note B	Measured in-situ
Chloride	Cl	1mg/l	5%	10%	
Sodium	Na	2mg/l	7%	10%	
Total oxidised nitrogen	TON	0.3mg/l	9%	10%	
Bromate as BrO_3	BrO_3	0.002mg/l	11%	10%	
Bromide	Br	0.005mg/l	16%	10%	

Notes to Table 3:

A. As defined in WRc report NS30.

B. Field instrument to be calibrated in accordance with manufacturer's instructions.

This action must be started within three months of the date of this notice and continued for five years.

H. **An Assessment Action must be undertaken as below.**

(a) Provide quality-assured monitoring data and report it to the Agency quarterly in January, April, July and October at the locations identified in Table 4 below for the parameters, and at the frequencies, in Table 2 above and to the detection limits, precision and bias in Table 3 above, unless otherwise agreed in writing with the Agency.

(b) Procedures for sampling, sample handling and sample analysis are to be as specified for Action F above

Table 4. Locations to be monitored under Assessment Action H

Loc ref	Site name	Type	NGR	Ownership
020	Cap's Cottages	P	TL 18377 09920	Mr A Sheriff, Nashes Farm

018	Fairfolds Farm	P	TL 18852 10141	Mr A Sheriff, Nashes Farm
059	Hatfield Quarry, WM1	M	TL 18800 08395	Cemex UK
375	Symonshyde Quarry, W29	M	TL 2129010670	Cemex UK
378	Symonshyde Quarry, W35	M	TL 20370 10445	Cemex UK
379	Symonshyde Quarry, W36	M	TL 21100 10500	Cemex UK
167	The Old Cottage, new bh	P	TL 21868 10722	Mr & Mrs N Redfern
191	M7, Mill Green Borehole	M	TL 23716 09780	Installed by Three Valleys on public access land.
005	Hatfield and London Country Club Workshop	P	TL 28234 08457	Hatfield & London Country Club
265	Park Street, Old Hatfield	M	TL 23410 08778	Installed by Three Valleys on verge of public highway.
195	M10, Sleapshyde OBH	M	TL 20251 06887	Installed by Three Valleys on public access land.
010b	BH by Block 3 (northernmost) Glinwell's Nursery	P	TL 19458 07443	Glinwell plc
041	Ellenbrook @ North Orbital Road (A414)	M	TL 20882 07164	Access from public highway
292	R Lee, Water Hall gauging station	S	TL 29967 09978	Access from public bridle path
101	River Lee downstream from Essendon Pumping Station (Holwell Bridge)	S	TL 27641 09814	Access from public highway
142	Roestock P.S. (raw water sampling point)	PWS	TL 21000 05900	Three Valleys Water plc
141	Tyttenhanger P.S. (raw water sampling point	PWS	TL 19820 05720	Three Valleys Water plc
143	Essendon P.S. (raw water sampling point)	PWS	TL 27330 09820	Three Valleys Water plc
144	Waterhall P.S. (raw water sampling point)	PWS	TL 29400 09500	Three Valleys Water plc
298	Broadmeads PWS	PWS	TL 35310 13960	Thames Water Utilities Ltd
295	Amwell End PWS	PWS	TL 35880 13990	Thames Water Utilities Ltd
296	Amwell Hill PWS	PWS	TL 36750 12760	Thames Water Utilities Ltd
297	Amwell Marsh PWS	PWS	TL 37620 12340	Thames Water Utilities Ltd
301	Rye Common PWS	PWS	TL 37950 11130	Thames Water Utilities Ltd
	Middlefield Road PWS	PWS	TL 37400 09500	Thames Water Utilities Ltd
300	Hoddesdon PWS	PWS	TL 37840 08980	Thames Water Utilities Ltd
299	Broxbourne PWS	PWS	TL 37300 07500	Thames Water Utilities Ltd
135	Turnford PWS	PWS	TL 36000 04440	Thames Water Utilities Ltd
M = monitoring borehole, P = private water supply, S = surface water, PWS = public water supply				

This action must be started within three months of the date of this notice and continued for five years.

I. **A Remedial Treatment Action must be undertaken in accordance with the requirements set out below unless varied in writing by the Environment Agency.**

(a) Pro[illegible]are the continuation of the existing scavenge pumping and treatment programme being car[illegible]ed out from the Three Valleys Water existing abstraction borehole at Bishops Rise, Hat[illegible]eld (Bishops Rise). For the purposes of this action the material features of the existing sca[illegible]enge pumping and treatment programme are as follows:

(i) Maintaining abstraction from Bishops Rise source. Actual abstraction rates are maximised on a day by day basis, taking into account constraints imposed by the treatment process, operational considerations and the capacity of the receiving sewer

system. Rainfall events have an impact on the attainable flows. Maximum rates of abstraction are 9 Ml/d (the licensed amount), with an average annual daily target of 6 Ml/d.

(ii) Dosing the abstracted water with ferrous chloride or an alternative suitable reducing agent of reasonable cost to reduce the bromate in the water to bromide.

(iii) Using a dedicated pipeline to remove the abstracted water to a trunk sewer system managed by Thames Water Utilities Ltd.

(iv) Monitoring water levels in the receiving sewer manhole and ensure that the discharge has no detrimental impacts on the sewer network.

(v) Monitoring at the locations and frequencies in Table 5 below for the parameters in Table 2 above and to the detection limits, precision and bias in Table 3 above, unless otherwise agreed in writing by the Agency.

(vi) Monitoring of bromate and bromide weekly, or at such other frequency as may be agreed in writing by the Agency, in the final effluent at the receiving sewage treatment works, Blackbirds and Maple Lodge.

(vii)Reporting the results of monitoring, under (iv) to (vi) above, to the Agency and in accordance with a scheme of reporting that has been agreed in writing by the Agency.

(b) In connection with this action the following definitions shall apply:

(i) "Procure" shall mean payment quarterly in arrears as follows:

1. To Three Valleys Water PLC, all costs solely attributable to pumping and treatment of bromate-contaminated groundwater, and associated costs of monitoring (at the locations and frequencies designated for Three Valleys Water in Table 5 below) and management.
2. To Thames Water Utilities Limited, all costs solely attributable to disposal of the treated groundwater by foul sewer and associated costs of monitoring ((at the locations and frequencies designated for Thames Water Utilities Ltd in Table 5 below) and management.

(ii) "Water Companies" shall mean Three Valleys Water PLC and Thames Water Utilities Limited or any successor(s) to their respective water undertakings.

(iii) "Required Concentration Standards" shall (other than those relating to sewage effluent, and unless otherwise agreed by the Agency) mean, in relation to each location in Table 5 below:

1. For bromate less than or equal to 5ug/l.
2. For bromide less than or equal to 500ug/l.

(iv) "Relevant Abstraction Points" shall mean the public water supply sources and associated monitoring points, other than those relating to sewage effluent, listed in Table 5 below.

This action must be commenced within one month of the date of this notice. It must be continued for the period defined by whichever is the shortest of (a) or (b) or (c) below:

(a) Until a long-term Remedial Treatment Action has been identified and implemented and shown to be at least as effective as action I in controlling concentrations of bromate at the Relevant Abstraction Points without any associated adverse environmental consequences;

(b) Until the Appropriate Person(s) demonstrate that the Required Concentration Standards have been achieved and can be maintained in the raw water abstracted from all the Relevant Abstraction Points, with the exception of Bishops Rise, without the continuation of such pumping at Bishops Rise;

(c) Ten years, or such shorter period as may be agreed in writing by the Agency.

Table 5. Locations to be monitored in connection with remedial treatment action I

Loc ref	Site name	Type	NGR	Designation (1) in relation to payments for monitoring	Frequency
143	Essendon PWS.	PWS	TL 27330 09820	TVW	Weekly
001	Bishops Rise PWS	PWS	TL 22000 07700	TVW	Weekly
298	Broadmeads PWS	PWS	TL 35310 13960	TWUL	Weekly
295	Amwell End PWS	PWS	TL 35880 13990	TWUL	Weekly
296	Amwell Hill PWS	PWS	TL 36750 12760	TWUL	Weekly
297	Amwell Marsh PWS	PWS	TL 37620 12340	TWUL	Weekly
301	Rye Common PWS	PWS	TL 37950 11130	TWUL	Weekly
	Middlefield Road PWS	PWS	TL 37400 09500	TWUL	Weekly
300	Hoddesdon PWS	PWS	TL 37840 08980	TWUL	Weekly
299	Broxbourne PWS	PWS	TL 37300 07500	TWUL	Weekly
135	Turnford PWS	PWS	TL 36000 04440	TWUL	Weekly
103	Chadwell Spring	PWS	TL 34997 13683	TWUL	Weekly
382	Lynch Mill Spring	S	TL 37711 08519	TWUL	Monthly
288	Stream from Arkley Hole spring, upstream of confluence with Lee	S	TL 28976 10021	TVW	Monthly
	River Colne at Green Bridge	S		TVW	Monthly
	Maple Lodge sewage treatment works final effluent	E		TWUL	Weekly
	Blackbirds sewage treatment works final effluent	E		TWUL	Weekly
S = surface water, PWS = public water supply, E = sewage effluent					

Note to Table 5.

(1) TVW = Three Valleys Water PLC, TWUL = Thames Water Utilities Ltd

SCHEDULE 3

(Particulars of the significant harm/pollution of controlled waters and particulars of substances (Regulation 4(1)(e) and (f))

The particulars of the pollutant linkages that form the basis of the determination of land as Contaminated Land and to which this Notice relate are set out below:

Pollutant linkage number	**Pollutant**	**Source location**	**Pathway**	**Receptor**	**Pollution of controlled waters**
1	Bromate	Soil at land identified in Schedule 1	Unsaturated zone and groundwater contained in, or in hydraulic continuity with the Chalk aquifer	Controlled waters: Groundwater contained in, or in hydraulic continuity with the Chalk aquifer.	Pollution of controlled waters is being caused.
2	Bromide	Soil at land identified in Schedule 1.	Unsaturated zone and groundwater contained in, or in hydraulic continuity with the Chalk aquifer	Controlled waters: Groundwater contained in, or in hydraulic continuity with the Chalk aquifer.	Pollution of controlled waters is being caused.

SCHEDULE 4

(Reasons for enforcing authority's decision on remediation requirements (Regulation 4(1)(g))

The final Remedial Treatment Actions which will enable the land and controlled waters to be effectively remediated, to the required standards, cannot yet be identified. This is because specific Assessment Actions are needed to characterise in detail the SPLs and to collect data to evaluate the likely effectiveness of Remedial Treatment Actions. Schedule 2 identifies a series of Assessment Actions that will enable Remedial Treatment Actions to be specified in one or more subsequent Remediation Notices. However pollution of controlled waters is continuing. Schedule 2 therefore also includes an interim Remedial Treatment Action which is required to be implemented in a timescale and in a form set out in Schedule 2

SCHEDULE 5

(other appropriate persons (Section 78E(3) of the 1990 Act and Regulation 4(1)(h), (i) and (j))

The following are the appropriate persons responsible for all of the assessment actions and the remedial treatment action described in Schedule 2 of this Notice for the following reasons

1. **Redland Minerals Limited of Granite House, Granite Way, Syston, Leicester, LE 7 1PL**

   Although they caused and knowingly permitted bromide to be in the land and are thereby responsible for the bromide SPL, at least in part, they are partly excluded from the bromide SPL by exclusion test 3, "sold with information" because Crest Nicholson Residential plc bought the land with the broad measure of the presence of the pollutant at that time.

   They are also partly responsible for the bromate SPL by virtue of causing the pollutant to be in the land.

2. **Crest Nicholson Residential plc of Crest House, 39 Thames Street, Weybridge, Surrey, KT13 8JL.**

   They are partly responsible for the bromide SPL by virtue of :

   a) Causing and knowingly permitting bromide to be in the land; and

   b) The other member of the liability group for this SPL, namely Redland Minerals Limited, are partly excluded by virtue of exclusion test 3 "sold with information" because Crest Nicholson Residential plc bought the land when they were in possession of information that would reasonably allow them to be aware of the presence on and in the land of bromide and the broad measure of that presence, at that time, and Redland Minerals Limited did nothing material to misrepresent the implications of that presence.

   They are also partly responsible for the bromate SPL by virtue of causing the pollutant to be in the land.

Proportion of Overall Costs to be borne:

Redland Minerals Limited:

Redland Minerals Limited bear 85% of costs associated with the bromate significant pollutant linkage (SPL) and 45% of costs associated with the bromide SPL that is:

Schedule 2 Actions D1, H and I – 85% of costs of these Single Linkage Actions as they are associated with the bromate SPL only.

Schedule 2 Action D2 – 45% of costs of this Single Linkage Action as this is associated with the bromide SPL only.

Schedule 2 Actions A, B, D, D3, G – - 65% of the costs of these Shared Common Actions. The Actions are referable to both bromide and bromate and are Actions which would have been part of the remediation package for each of the bromide and the bromate SPLs had they been addressed separately. The cost is therefore shared equally between the bromate and bromide SPLs.

Schedule 2 Action C –72% of the cost of this Shared Collective Action. Action C is referable to both bromide and bromate; however, if taken individually, the actions for each SPL would not be identical. In particular the scope of bromate modelling would have to cover double the area of the bromide modelling. It is therefore considered that the cost of the bromate modelling, which is subsumed within Schedule 2 Action C, would be 66.7% of the cost of the Action as a whole and that the cost of bromide modelling would take up the remaining 33.3%. Therefore Redland Minerals Limited are responsible for 85% of 66.7% of the cost and for 45% of 33.3% of the cost.

Schedule 2 Action F1, – 65% of the cost of this Shared Collective Action. Action F1 is referable to both bromide and bromate; however, if taken individually, the actions for each SPL would not be identical. In particular some locations may be referable to bromate only and some to bromide only. The hypothetical costs of each are likely to be the same. It is therefore considered that Redland Minerals Limited are responsible for 85% of 50% and for 45% of 50% of the cost of the Action as a whole.

Crest Nicholson Residential plc:

Crest Nicholson Residential plc bear 15% of costs associated with the bromate SPL and 55% of costs associated with the bromide SPL that is:

Schedule 2 Actions D1, H and I – 15% of costs of these Single Linkage Actions as they are associated with the bromate SPL only.

Schedule 2 Action D2 – 55% of costs of this Single Linkage Action as it is associated with the bromide SPL only.

Schedule 2 Actions A, B, D, D3, G – 35% of the costs of these Shared Common Actions. The Actions are referable to both bromide and bromate and are actions which would have been part of the remediation package for each of the bromide and the bromate SPLs had they been addressed separately. The cost is therefore shared equally between the bromate and bromide SPLs.

Schedule 2 Action C – 28% of the cost of this Shared Collective Action. Action C is referable to both bromide and bromate; however, if taken individually, the actions for each SPL would not be identical. In particular, the scope of bromide modelling would have to cover only half the area of the bromate modelling. It is therefore considered that the cost of the bromide modelling, which is subsumed within Schedule 2 Action C, would be 33.3% of the cost of the Action as a whole and that the cost of bromate modelling would take up the remaining 66.7%. Therefore Crest Nicholson Residential plc are responsible for 55% of 33.3% of the cost and for 15% of 66.7% of the cost.

Schedule 2 Action F1, – 35% of the costs of this Shared Collective Action. Action F1 is referable to both bromide and bromate; however, if taken individually, the actions for each SPL would not be identical. In particular some locations may be referable to bromate only and some to bromide only. The hypothetical costs of each are likely to be the same. It is therefore considered that Crest Nicholson Residential plc are responsible for 15% of 50% and for 55% of 50% of the cost of the Action as a whole.

SCHEDULE 6

(Names and addresses of owners and occupiers of the contaminated land to which this notice relates and persons whose consent is required for remediation purposes (Regulation 4(1)(k) and (l)))

The owners and occupiers of the contaminated land are:

Freehold owner of land: Beechgrove (Sandridge) Management Limited

The names and addresses of persons whose consent is required under section 78G(2) of the 1990 Act are:-

Mr P Hyde (Director), Beechgrove (Sandridge) Management Ltd, 18 St Leonards Court, House Lane, Sandridge, St Albans, Herts AL4 9UY
Beaufort Trust Corporation Ltd and Lady Mary June Meaney, 11 Church End, Sandridge, St Albans, Herts AL4 9DL
Territorial Property Director, Salvation Army Trustee Company. 101 Newington Causeway, London SE1 6BN
Mr R Irving, Orchard Garage, Woodcock Hill, Sandridge, St Albans, Herts AL4 9EE
Mr C H Franklin, Principal Land Agent, Hertfordshire County Council, County Hall, Pegs Lane, Hertford SG13 8DN
Mr A Sheriff, Nashes Farm House, Sandridge, St Albans, Herts AL4 9HF
Mr & Mrs N Redfern, Old Cottage, Green Lanes, Hatfield, Herts AL10 9BH
Mr J Takeda (fao Mr Peter Creary), Hatfield and London Country Club, Bedwell Park, Essendon, Hatfield, Herts AL9 6HN
Mr P Clegg, Chief Executive, Estate Office, Hatfield Park , , Hatfield, Herts AL9 5NQ
Mr S Redwood, Estates and Development Manager, RMC Materials Ltd, Cemex UK Operations, Cemex House, Evreux Way, Rugby, Warwickshire CV21 2DT
Mr M Simon, Glinwell plc, Hatfield Road, Smallford, nr St Albans, Herts AL4 0HD
Mr J Godbold (fao Mr Neil Agnew), Woolmers Park, Letty Green, Herts SG14 2NX
Mr A Hodson, Solicitor, Three Valleys Water plc, PO Box 48, Bishops Rise, Hatfield, Herts AL10 9HL
Mr B Connorton, Raw & Waste Water Manager, Thames Water Utilities Ltd, Clearwater Court, Vastern Road, Reading, Berks RG1 8DB

SCHEDULE 7
(Offences, penalties and Appeals)

Offences, Penalties and Appeals (Regulation 4(1),(n) and (o), Regulation 4(2)(a), (b) and (c))

Offences and Penalties (section 78M of the 1990 Act)

- Under section 78M of the 1990 Act, it is an offence to fail, without reasonable excuse, to comply with any of the requirements of this Notice.

- A person who commits such an offence is liable to the following penalties:

– Where the contaminated land to which the notice relates is "industrial, trade or business premises" as defined in section 78M(6) of the 1990 Act, on summary conviction, to a fine not exceeding £20,000 or such greater sum as the Secretary of State or National Assembly of Wales, may from time to time by order substitute and to a further fine of an amount equal to one-tenth of that sum for each day on which the failure continues after conviction of the offence and before the enforcing authority has begun to exercise its powers by virtue of section 78N(3)(c) of the 1990 Act.
– Where the contaminated land to which the notice relates is not "industrial, trade or business premises", on summary conviction, to a fine not exceeding level 5 on the standard scale and to a further fine of an amount equal to one-tenth of level 5 on the standard scale for each day on which the failure continues after conviction of the offence and before the enforcing authority has begun to exercise its powers by virtue of section 78N(3)(c).

Right of Appeal (section 78L of the 1990 Act)

You have a right of appeal against this Notice, under section 78L of the 1990 Act. If you wish to appeal you must do so, within the period of twenty-one days beginning with the day on which the notice is served:
(a) if it was served by a local authority, to a magistrates' court; or
(b) if it was served by the Environment Agency, to the Secretary of State or National Assembly for Wales.

Appeals to a Magistrates' Court (Regulation 8)

- Regulation 8 states the following:
(1) An appeal under section 78L(1) to a magistrates' court against a remediation notice shall be by way of compliant for an order and, subject to section 78L(2) and (3) and regulations 7(3), 12 and 13, the Magistrates' Courts Act 1980 shall apply to the proceedings.
(2) An appellant shall, at the same time as he makes a compliant,-
  (a) file a notice ("notice of appeal") and serve a copy of it on –
    (i) the enforcing authority;
    (ii) any person named in the remediation notice as an appropriate person;
    (iii) any person named in the notice of appeal as an appropriate person;
    (iv) any person named in the remediation notice as the owner or occupier of the whole or any part of the land to which the notice relates;
  (b) file a copy of the remediation notice to which the appeal relates and serve a copy of it on any person named in the notice of appeal as an appropriate person who was not so named in the remediation notice; and

(c) file a statement of the names and addresses of any persons falling within paragraph (ii), (iii) or (iv) of sub-paragraph (a) above.

(3) The notice of appeal shall state the appellant's name and address and the grounds on which the appeal is made.

[Note: "file" means deposit with the justices' chief executive in England or Justices clerk in Wales]

- Further information relating to appeals to a magistrates' court is given in Circular 02/2000, Annex 4 "Guide to the Contaminated Land (England) Regulations 2000" or relevant National Assembly for Wales Guidance.

Appeals to the Secretary of State (Regulation 9)

- Regulation 9 states the following:

(1) An appeal to the Secretary of State (or National Assembly for Wales) against a remediation notice shall be made to him by a notice ("notice of appeal") which shall state –
(a) the name and address of the appellant;
(b) the grounds on which the appeal is made; and
(c) whether the appellant wishes the appeal to be in the form of a hearing or to be disposed of on the basis of written representations.

(2) The appellant shall, at the same time as he serves a notice of appeal on the Secretary of State (or National Assembly for Wales),-
(a) serve a copy of it on –
(i) the Environment Agency;
(ii) any person named in the remediation notice as an appropriate person;
(iii) any person named in the notice of appeal as an appropriate person; and
(iv) any person named in the remediation notice as the owner or occupier of the whole or any part of the land to which the notice relates;
and serve on the Secretary of State (or National Assembly for Wales) a statement of the names and addresses of any persons falling within paragraph (ii), (iii) or (iv) above; and
(b) serve a copy of the remediation notice to which the appeal relates on the Secretary of State (or National Assembly for Wales) and on any person named in the notice of appeal as an appropriate person who is not so named in the remediation notice.

- Appeals to the Secretary of State (England) should be submitted to the Planning Inspectorate. Their current address and telephone number are as follows: The Planning Inspectorate, Room 4/19, Eagle Wing, Temple Quay House, 2 The Square, Temple Quay, Bristol, BS1 SPN. Tel: 0117 372 6372. Appeals to the Secretary of State (Wales) should be submitted to the National Assembly for Wales, Environment Division, Cathays Park, Cardiff CF10 3NQ Tel: 029 2082 5546.

Grounds of Appeal (Section 78L of the 1990 Act and Regulation 7)

(1) The grounds of appeal against a remediation notice pursuant to section 78L of the 1990 Act are any of the following:-

(a) that, in determining whether any land to which the notice relates appears to be contaminated land, the local authority-
(i) failed to act in accordance with guidance issued by the Secretary of State (or National Assembly for Wales) under section 78A(2), (5) or (6); or

(ii)whether by reason of such a failure or otherwise, unreasonably identified all or any of the land to which the notice relates as contaminated land;

(b) that, in determining a requirement of the notice, the enforcing authority-
(i) failed to have regard to guidance issued by the Secretary of State (or National Assembly for Wales) under section 78E(5); or
(ii)whether by reason of such a failure or otherwise, unreasonably required the appellant to do any thing by way of remediation;

(c) that the enforcing authority unreasonably determined the appellant to be the appropriate person who is to bear responsibility for any thing required by the notice to be done by way of remediation;

(d) subject to paragraph (2) below, that the enforcing authority unreasonably failed to determine that some person in addition to the appellant is an appropriate person in relation to any thing required by the notice to be done by way of remediation;

(e) that, in respect of any thing required by the notice to be done by way of remediation, the enforcing authority failed to act in accordance with guidance issued by the Secretary of State (or National Assembly for Wales) under section 78F(6);

(f) that, where two or more persons are appropriate persons in relation to any thing required by the notice to be done by way of remediation, the enforcing authority-

(i) failed to determine the proportion of the cost stated in the notice to be the liability of the appellant in accordance with guidance issued by the Secretary of State (or National Assembly for Wales) under section 78F(7); or
(ii)whether, by reason of such a failure or otherwise, unreasonably determined the proportion of the cost that the appellant is to bear;

(g) that service of the notice contravened a provision of subsection (1) or (3) of section 78H (restrictions and prohibitions on serving remediation notices) other than in circumstances where section 78H(4) applies;

(h) that, where the notice was served in reliance on section 78H(4) without compliance with section 78H(1) or (3), the enforcing authority could not reasonably have taken the view that the contaminated land in question was in such a condition by reason of substances in, on or under the land, that there was imminent danger of serious harm, or serious pollution of controlled waters, being caused;

(i) that the enforcing authority has unreasonably failed to be satisfied, in accordance with section 78H(5)(b), that appropriate things are being, or will be, done by way of remediation without service of a notice;

(j) that any thing required by the notice to be done by way of remediation was required in contravention of a provision of section 78J (restrictions on liability relating to the pollution of controlled waters);

(k) that any thing required by the notice to be done by way of remediation was required in contravention of a provision of section 78K (liability in respect of contaminating substances which escape to other land);

(l) that the enforcing authority itself has power, in a case falling within section 78N(3)(b), to do what is appropriate by way of remediation;

(m)that the enforcing authority itself has power, in a case falling within section 78N(3)(e), to do what is appropriate by way of remediation;

(n) that the enforcing authority, in considering for the purposes of section 78N(3)(e), whether it would seek to recover all or a portion of the cost incurred by it in doing some particular thing by way of remediation-

(i) failed to have regard to any hardship which the recovery may cause to the person from whom the cost is recoverable or to any guidance issued by the Secretary of State (or National Assembly for Wales) for the purposes of section 78P(2); or
(ii)whether by reason of such a failure or otherwise, unreasonably determined that it would decide to seek to recover all of the cost;

(o) that, in determining a requirement of the notice, the enforcing authority failed to have regard to guidance issued by the Environment Agency under Section 78V(1);

(p) that a period specified in the notice within which the appellant is required to do anything is not reasonably sufficient for the purpose;

(q) that the notice provides for a person acting in a relevant capacity to be personally liable to bear the whole or part of the cost of doing any thing by way of remediation, contrary to the provisions of section 78X(3)(a);

(r) that service of the notice contravened a provision of section 78YB (interaction of Part IIA of the 1990 Act with other enactments), and-

(i) in a case where subsection (1) of that section is relied on, that it ought reasonably to have appeared to the enforcing authority that the powers of the Environment Agency under section 27 might be exercised;
(ii)in a case where subsection (3) of section 78YB is relied on, that it ought reasonably to have appeared to the enforcing authority that the powers of a waste regulation authority or waste collection authority under section 59 might be exercised; or

(s) that there has been some informality, defect or error in, or in connection with, the notice, in respect of which there is no right of appeal under the grounds set out in sub-paragraphs (a) to (r) above.

(2) A person may only appeal on the ground specified in paragraph (1)(d) above in a case where-

(a) the enforcing authority has determined that he is an appropriate person by virtue of subsection (2) of section 78F and he claims to have found some other person who is an appropriate person by virtue of that subsection;

(b) the notice is served on him as the owner or occupier for the time being of the contaminated land in question and he claims to have found some other person who is an appropriate person by virtue of that subsection; or

(c) the notice is served on him as the owner or occupier for the time being of the contaminated land in question, and he claims that some other person is also an owner or occupier for the time being of the whole or part of that land.

(3) If and in so far as an appeal against a remediation notice is based on the ground of some informality, defect or error in, or in connection with, the notice, the appellate authority shall dismiss the appeal if it is satisfied that the informality, defect or error was not a material one.

Suspension of Remediation Notice Upon Appeal (Regulation 14)

Once an appeal has been duly made, the relevant remediation notice is suspended until the appeal is finally determined or is withdrawn (abandoned) by you. "Duly made" for this purpose means that an appeal must be made within the time limit, and in accordance with the Regulations.

APPENDIX 2
ANALYSIS OF REPORT F1

Abbreviations in the Glossary apply to this appendix.

I. Introduction

1. There was a detailed text in Appendix 2 of the CD that has been commented upon and we have revised this appendix in the DD as a result. Unlike the main text, paragraphs are numbered sequentially and therefore paragraph numbers have changed since the CD. It provides a supporting document for the conclusions in the DD, it is not a comprehensive reply to the consultation.

2. The First Notice (see Appendix 1) required the APs to submit a report which considered the Remediation Options (Assessment Action F1). This report was prepared by MJCA in collaboration with Environmental Resources Management (ERM) on behalf of the APs, entitled *Consideration of the Options and the Best Practicable Technique for the Remediation of the Bromate and Bromide Contamination in Groundwater* (Report F1) and submitted to the Agency on 16th July 2018.

3. Assessment Action F1 required the APs, using the information gained from the earlier Assessment Actions (namely D, D1, D2, D3 and E of the First Notice), to assess the practicality, effectiveness and durability of each option and to evaluate which of the options amounted to the best practicable technique. The evaluation was to include a comparison of the cost benefit analysis for each option.

4. Since Report F1 is the culmination of all the assessment actions in the First Notice, other than the ongoing monitoring assessment actions, it forms an important milestone.

5. This appendix supports Section O of the main text in providing a more detailed review of Report F1 by means of additional explanation and references in full. The review is undertaken only insofar as it has a bearing on the production of a possible Second Notice. It is not designed to give an alternative assessment of the data but more to point out where there appears to be insufficient evidence to support the conclusions of Report F1.

6. Report F1 is supported by a series of tables, figures and appendices. Monitoring data is summarised in Section 4 and Appendices B, C and E provide a comprehensive set of graphs of concentration variation over time, and concentrations in relation to groundwater levels, based on the data provided in Appendix A.

7. Part 2 of the Agency's Consultation Document contains all the figures referred to in this appendix and includes maps and graphs derived from the data in Report F1, Appendix A to illustrate the points made in the following sections. Many of the figures are at a larger scale than those in Report F1 as an aid to the reader of this appendix. Figures A to H are maps and Figures J to P are graphs.

8. The bromate and bromide plume maps in Figures 4 and 5 of Report F1 are based on average concentrations from groundwater sampled during 2016 and 2017. It is more appropriate to use the Agency means which are averaged over five years (Jan 2013 – Dec 2017)) as representative of recent concentrations. This period covers a range of groundwater level conditions whereas 2016 to 2018 has been relatively dry with unusually low groundwater levels. However, the overall concentrations and distribution of bromate and bromide is much the same for the two sets of data. This demonstrates the general stability of the plumes. Therefore, in the interests of a common understanding, the Agency has included the APs' bromate plume map as Figure A. This is indicative of the general area, and extent of the plume which drives the need for the interim urgent remediation, as set out in Action I of the First Notice. The Agency's average concentration values for the period 2013 to 2017 are presented in Table B and shown on Figures B, C and E, in order moving eastwards from SLCourt. The three figures combined show the whole area of the plumes. A series of different scale maps are necessary to clearly depict concentration values. Groundwater concentrations beneath SLCourt and down hydraulic gradient remain high. At SLCourt bromate concentrations are in excess of 2000 µg/l, and those of bromide up to 256,260 µg/l (Figure B).

9. The APs have not taken issue with the above points which are purely factual. In Annex C of their consultation response (Annex C_Crest) they include an executive summary which states there are a number of areas of the CD in which the Environment Agency (EA) makes statements or draws conclusions with which the APs do not agree. They therefore include further detailed technical comments which the Agency welcomes. However, it remains that there is no clear conceptual model to provide understanding of the hydrogeological mechanisms at work. The APs refer to a conceptual model presented by the Agency. We have not presented an alternative conceptual model. The Agency do not believe there is sufficient evidence for all of the APs' conclusions in Report F1 and demonstrated this in the CD by some alternative interpretations as examples.

10. The Agency does not agree with all the conclusions that have been drawn in Report F1. Section O of the main text uses five headings for the key points of agreement and disagreement with a brief concluding section 6. The five headings are:

1. **most cost-effective option** (expanded with more details below);

2. **the evidence for contaminant migration** (expanded with more details below and is further sub-divided);

3. **remediation options;**

4. **treatment options;**

5. **duration of remediation** (expanded with more details below).

1. Most Cost-Effective Option

11. The evaluation by the APs of the options under F1 was intended to include a comparison of the cost benefit analysis for each option. The Report F1 that has been submitted only proposes one option, the continuation of scavenge pumping at Bishop's Rise and does not therefore include any comparative cost benefit analysis. The Agency does not accept that this is the only possible option for the reasons explained in this appendix, particularly section III, Contaminant Migration. We consider that further information is required and therefore the Second Notice includes Assessment Actions to allow other options to be assessed.

12. As explained in the main text in Section O.1, paragraphs 63 to 63g, the additional work undertaken by the APs in their consultation response (Annex C_Crest, paragraphs 65 to 68), whilst useful does not provide all the elements of a full cost benefit analysis.

13. Therefore the criticism made by the Inspector at the Public Inquiry remains for the time being:

    IR872 Given the urgent need for action, it is hard to imagine a better interim measure. Nevertheless, I recognise that the annual operating costs, which are estimated to be about £570,000 - £660,000, have not been compared in any transparent and meaningful way with the costs of possible alternatives.

14. In Report F1, Table 5, under the entry for RB1 - abstract at Bishop's Rise, it is stated that the "cost benefit consideration" is to be established. It is not clear what this means. The fact that the Water Companies scavenge pumped before the APs procured its continuation under the First Notice suggests that it is cost beneficial. .

15. The comparison between Bishop's Rise and Orchard Garage does demonstrate the value of Bishop's Rise, but it does not show that other options are not worth considering. The statement made at IR 791 remains the case, that the alternatives are not capable of being dismissed at the present time.

2. The evidence for contaminant migration

16. The section forms the largest part of this appendix and is divided into four parts:

    (i) an introductory section on the conceptual model to set the scene;

    (ii) a discussion of the concentration trend reversal along the plumes centre line, proposed in Report F1 and dividing the plumes approximately at Bishop's Rise, into:

    (iii) up hydraulic gradient of Bishops Rise;

    (iv) down hydraulic gradient of Bishop's Rise.

(i) Conceptual Model

17. A conceptual model is a representation of the characteristics of a site that shows the possible relationships between contaminants, pathways and receptors. The main elements of a conceptual model were discussed and agreed at the Public Inquiry. The APs have subsequently refined this in accordance with CLR11, through assessment actions, including Report F1. However, some key information is still absent.

18. Review of the monitoring data has not included correlation between monitoring points. The depth, and more particularly, stratigraphic level of monitoring point response zones varies at the different locations and needs to be taken into account though the Agency does acknowledge that there is probably insufficient information on borehole construction and depth to be able to correlate between boreholes correctly. It may therefore not be appropriate to directly compare groundwater level and contaminant concentration data between monitoring points.

19. Groundwater flow direction and change over time due to seasonal or other factors based on the monitoring data was not included, or even considered. Groundwater contour maps are normally seen as fundamental to a conceptual understanding. The only indication of groundwater flow direction

in Report F1 is from the contaminant plume maps that have been produced for bromate and bromide (Report F1, Figures 4 and 5). The time lag in contaminant movement within the aquifer means that the plumes are likely to show a representative but averaged, pattern and any variations demonstrated by the more rapid response of groundwater levels could be masked.

20. In their response to the consultation the APs (Annex A_Crest, paragraph 65) have confirmed that groundwater flow directions do not appear to vary seasonally or with changes in groundwater levels. The Agency agrees but believes that groundwater flow direction and any changes need to be kept under review as many uncertainties remain - for example the influence of abstraction boreholes as mentioned in paragraph 19 below. The Agency's maps (Figures F, G and H, in order moving eastwards from SLCourt) show the highest (April 2014) and lowest (October 2017) groundwater levels from the APs' database for the five year period 2013 to 2017 inclusive. The months chosen to show the high and low values are based on levels recorded at SLCourt and may not record highest and lowest groundwater levels throughout the plume. The five year period is the same as that used by the Agency to calculate average bromate and bromide concentrations. The maps also show the Agency's regional groundwater level contours based on representative maximum groundwater level prior to 1998.

21. The Agency has not assessed the APs' groundwater level data in detail but the high values are broadly similar to the regional groundwater contours. The high density of abstraction boreholes relative to few monitoring locations may limit detailed analysis but if so, this needs be explained and identified as an uncertainty as part of the conceptual model.

22. The Agency accepts that the situation is a complex one, and groundwater quality monitoring results are difficult to interpret with confidence. For instance: isolated peaks for a number of contaminants as well as bromate and bromide do occur at Essendon; Orchard Garage has shown concentrations which appear to be lower than those both up and down gradient; and the NNR wells contaminant concentration relationship to both groundwater levels and Bishop's Rise abstraction rate has many variables.

Secondary Sources?

23. One aspect of the conceptual model is the significance of secondary sources, that is, sources down hydraulic gradient of the SLCourt site (the primary source) that have resulted from the contaminant plumes and now form additional contaminant sources within the saturated aquifer.

24. Paragraph 3.4 of Report F1 refers to a secondary source in the saturated Chalk blocks down gradient of SLCourt:

> *3.4 As a result of the high concentrations of pollutants in the groundwater in the fissures close to SLC compared with the concentrations in the groundwater in the down hydraulic gradient chalk blocks it is likely that a significant proportion of pollutants down gradient of SLC migrate by diffusion into the groundwater in the chalk blocks. Consequently it is likely that when the concentrations of pollutants in the groundwater in the fissures are lower than the concentrations of the pollutants in the groundwater in the chalk blocks, the chalk blocks down hydraulic gradient of SLC can act as a secondary source of pollutants. For the purpose of reviewing the remediation options it is considered that in addition to the primary sources of pollutants presented in the conceptual site model the blocks of the saturated chalk down hydraulic gradient of SLC should be considered to act as a potential secondary source. The receptors . . .*

The Agency agrees with the theoretical principle presented and it may be valid in some parts of the plumes but there is no evidence that this stage has been reached. Indeed there is evidence that it has not. The OG Investigation includes a vertical profile in borehole 1 reproduced here as Figure I. This shows that pore water concentrations were lower than in groundwater within the fissures. Although this is the only case where such a comparison can be made, it indicates that concentrations are being maintained from up gradient of Orchard Garage and are not decreasing. Therefore the evidence suggests that the centres of the plumes have not migrated down gradient of Orchard Garage as Report F1 suggests.

25. Further, paragraph 8.22 acknowledges that the extent to which bromate and bromide have entered the pores within the Chalk matrix is unknown because of the variable nature of the Chalk and that it is therefore difficult to estimate the duration of remediation:

> *8.22 The degree to which bromate and bromide have entered the Chalk matrix blocks will be variable spatially within the plume and could be affected by many factors for example whether contaminants are flowing predominantly along discrete pathways such as a relatively small number of conduits enhanced by solution or in numerous pathways comprising an interconnected and widely distributed fracture network occupying a large volume of aquifer. Because the spatial distribution of contaminant mass in the Chalk matrix in different parts of the plume is not known, and cannot reasonably be established in a high level of detail over the entire area of the plume, it is not possible to estimate with*

confidence the total mass of contaminant within the plume or the rate at which contaminant mass will diffuse out of the Chalk matrix or how the rate of removal of mass from the Chalk matrix will vary with time. On this basis it is difficult to estimate the duration of remediation.

26. The APs suggest in Annex C_Crest, paragraph 12 that the rate of diffusive exchange between the matrix and fractures locally may have been sufficient for the concentrations in the pore water to have also reduced significantly. That may be the case but there is no simple mechanism by which pore water concentration could be high and then reduce to below fissure water concentrations. Therefore the Agency's position remains that there is no evidence for the presence of secondary sources within the saturated aquifer but they may exist, albeit unproven, in certain parts of the aquifer.

27. The reference to secondary sources of pollutants in Report F1, paragraph 3.4 only refers to those in the saturated zone but those in the zone of fluctuation (the zone between lowest and highest groundwater levels) down gradient of SLCourt could be significant when groundwater levels change. In Annex B_Crest at paragraph 25 the APs state that Chalk that is rarely below the groundwater level probably will not be a major repository for contaminants. Therefore there is agreement that this is a matter of uncertainty.

28. In the vicinity of Hatfield Quarry the Chalk is overlain by a thick layer of Glacial Deposits associated with the proto-Thames. Typically the Glacial Deposits comprise gravels that are sub-divided by a layer of Boulder Clay. The lower gravel layer is in hydraulic continuity with the Chalk aquifer. In similar settings where a contaminated Chalk aquifer is overlain by gravels, the latter have been shown to act as a reservoir for the contaminant. In Annex B_Crest, paragraph 25 the APs do not comment on the significance of the saturated gravels.

29. In Annex C_Crest, paragraph 2, the APs say it is reasonable to consider potential secondary sources in the review of possible remediation options. In spite of the uncertainties and lack of evidence referred to in paragraphs 24 to 27 above, the Agency agrees. However, the Agency considers the likelihood of a secondary source has not been carried through to remediation options proposed by the APs.

30. For the conceptual model as a whole, there remains considerable uncertainty in interpretation of the hydrogeological conditions.

(ii) Concentration trend reversal along the plumes centre line

31. Paragraphs 4.36 and 4.37 and Figures 4A and 5A of Report F1 suggests a decreasing trend in concentration in the upper part of the plumes and an increasing trend in the lower part consistent with the centre of the contaminant mass migrating down gradient away from the SLCourt source area.

> *4.36 There is evidence that the distribution of contaminant mass longitudinally (west to east) along the plume has changed over time. Figures 4A and 5A show the variation in bromate and bromide concentrations respectively for 2001, 2006, 2009, 2013 and 2017 in a longitudinal transect of monitoring locations 223 (SLC), 028 (Orchard Garage), 226 (Harefield House), 19 (Nashes Farm), 62 (Hatfield Quarry), 402 (Comet Way), 001 (Bishops Rise), 300 (Hoddesdon) which it is considered are close to the approximate centreline of the plume generally and for which a suitable long term record of monitoring data is available. The same transect is representative of the approximate centreline of both the bromate and the bromide plumes. The y-axis (concentration) has a log scale and the x-axis is the approximate distance of the monitoring locations from SLC. For convenience, data for monitoring location 300 (Hoddesdon) are plotted as 8km from SLC rather than the actual distance of approximately 20.8km.*
>
> *4.37 Based on Figure 4A bromate concentrations generally have been reducing with time in the area between SLC and Hatfield Quarry and increasing further down hydraulic gradient from Hatfield Quarry eastwards. Significantly greater concentrations of bromate were recorded at SLC historically than are recorded in recent years. On this basis a significant proportion of the bromate giving rise to the elevated concentrations in the down hydraulic gradient part of the plume almost certainly have been released from the source decades ago. It can be interpreted that the centre of mass of the bromate in the plume is migrating down hydraulic gradient with time.*

Some of the evidence provided makes assumptions which the Agency does not accept; there are other explanations for the changes in concentration which are equally, or more, valid.

32. The two opposing concentration trends observed in different parts of the plumes, a reducing trend in the upper part of the plumes and an increasing trend in the lower part, could be explained in part by a spreading plume or specific activities in or near the source area, with respect to the upper part of the plumes, and reduction in Bishop's Rise abstraction in the lower part of the plume.

33. The Agency welcomes the additional assessment that the APs have carried out in Annex C_Crest of their consultation response demonstrating that the evidence does not support a close relationship between high concentrations and the unusually high groundwater levels. We accept this.

34. However, if the trend observed at SLCourt is back extrapolated to before the site investigation took place at SLCourt, some very high concentrations would have occurred as a distinct peak between the 1980s and the 2000s. Although not impossible, it is difficult to envisage a mechanism whereby concentrations would have risen so markedly after the redevelopment had taken place at SLCourt.

35. A peak as described above is likely to have led to high contaminant concentrations in any secondary sources which may exist. These are unlikely to be as high as the peak concentrations in the fissure water but could be near to it. This is one of the reasons for the Agency's change in emphasis with respect to assessment actions as described in 109a to 109c of the main text.

36. Report F1, 4.37 describes the change in concentration trend as at Hatfield Quarry. However, Figures 4A (bromate) and 5A (bromide) show the change as occurring at an approximate distance of 4.5km from SLCourt, which is mid-way between Hatfield Quarry and Bishop's Rise and West of the A1(M) cut-and-cover tunnel. The Agency believes the precise location of the change in trend is unimportant and as the number of monitoring points nearby is limited, the location of the point at which the change occurs is dependent upon interpolation and it can therefore only be approximate. The similarity in the location of the change in concentration trend of bromate and bromide may be of greater significance. If real, it suggests the trend change is caused, at least in part by a physical change within the aquifer, by abstraction at Bishop's Rise, for example. If natural migration was the sole cause, the Agency might expect a difference in location between the bromate and bromide change since the larger, less mobile bromate molecules are expected to lag behind bromide. However, as described, the approximate nature of the location of the concentration trend change may mean that any difference, if there is one, would not be detected.

37. Following the suggestion in paragraphs 32 and 36 above that abstraction is a contributory factor and notwithstanding the actual location at which the APs suggest the change in concentration trend occurs, we have used Bishop's Rise as the change location for the purposes of the remainder of this document. There are other abstractions in the vicinity which may have an influence. These are: dewatering at the A1(M) tunnel, Hatfield Business Park abstraction (location 002) and abstractions at Hatfield Quarry.

38. The following discussion of groundwater contaminant concentrations is divided into up hydraulic gradient, and down hydraulic gradient of Bishop's Rise.

(iii) Up hydraulic gradient of Bishop's Rise

39. As discussed in paragraphs 31 to 33 and 36 above, a key hypothesis in Report F1 is that the centre of mass of the plumes is migrating down gradient and contaminant concentrations are now falling in the upper part of the plumes. Report F1 uses this hypothesis to argue that scavenge pumping at Bishop's Rise is preferable to pumping up gradient.

40. At the time of the Public Inquiry, it was expected that the final remediation would include scavenge pumping up gradient of Bishop's Rise. The Inspector concluded that it would seem preferable to pump from a location, or locations, closer to SLCourt than Bishop's Rise and where the plume is narrower and the contaminant concentrations are higher, and this needed further assessment (IR 855 to 858).

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41. The Agency believes there is insufficient evidence for the APs' suggestion that the mass of the contaminant within the plumes has moved down gradient, and will continue to do so, at a rate such that there is no value in an additional scavenge pumping site up gradient. The APs' view is described in paragraphs 8.4, 8.5 and 8.7 of Report F1:

> *8.4 However, as identified in the review of the monitoring data set out in section 4 of this report, the concentrations of the contaminants in the groundwater at the approximate location of Orchard Garage passed their peak concentrations before 2003 and at borehole 028 (Orchard Garage) the concentration of bromide has been generally level since around 2015 and at or around the remediation level (Appendix B). At borehole 028 the concentration of bromate is above but on a trend which is gradually reducing towards the remediation level (Appendix B). At the nearby boreholes at Harefield House (GW12, 226) and Nashes Farm (019) the patterns of reducing concentrations are similar. . .*
>
> (Please note the Harefield House borehole number is GW13, not GW12)
>
> *8.5 Scavenge pumping in the vicinity of Orchard Garage would have potentially been an effective and sustainable location when the concentrations of the Contamination were higher. However, as the concentrations of the Contamination at Orchard Garage now are reducing and are lower than the concentrations in the groundwater further down gradient, such as at Bishops Rise, the area around*

Orchard Garage is no longer considered the best location for removing contaminant mass in the most effective way. Whilst scavenging abstraction(s) in the vicinity of Orchard Garage would remove some contaminant mass, as there are higher concentrations of contaminants in the groundwater down gradient of Orchard Garage it is likely to have limited direct benefit in providing protection to the public supply abstraction wells. The relative concentrations of bromate and bromide in the plume over time along the approximate centreline of the plume are shown on Figures 4 and 5 respectively.

The Agency wants scavenging additional to Bishop's Rise to be explored. A further, longer pumping trial than the one carried out to date would demonstrate the value or otherwise of pumping from Orchard Garage or elsewhere and show if concentrations vary with seasonal groundwater level change under pumping conditions. A longer pumping trial also allows for a variety of pumping regimes to be explored.

42. Scavenge pumping at Bishop's Rise, Action I of the First Notice, was an immediate action to protect public water supply abstractions down gradient of Bishop's Rise whilst assessment actions were completed to identify the best practicable technique. It is an interim measure and only relates to the lower part of the bromate plume.

43. The following sections consider contaminant monitoring data from different parts of the upper part of the plumes. The Agency note that this is against a background of groundwater levels which have not been as high since 2000/1, or before within living memory, although there have been fluctuations. Figures J1-J4 present data from four hydrometric sites showing the unusually and consistently high groundwater levels across the area in 2000/1. All four sites are within 10 kilometres of SLCourt and includes Orchard Garage.

SLCourt

44. SLCourt itself is a complex site including some discrete sources of bromate and bromide. Some monitoring locations at SLCourt show there has been a fall to quite low concentrations, at others, less so. Although significant peaks, such as in the early 2000s and around 2009, and troughs occur, overall the boreholes on SLCourt show remarkably stable conditions. Figure K illustrates the peaks and troughs observed in bromate concentration but with no clear trend over time, at borehole GW10. The Agency would expect there to have been some reduction since the 1980s as a result of the partial contaminant removal from the site. The Agency agrees with the facts presented in the following statement in Report F1 but not that they necessarily represent an overall falling trend :

4.12 Although there are monitoring locations at SLC where high concentrations of bromate and bromide continue to be recorded since 2010 generally there has been a sustained reduction in the concentrations recorded. Bromate and bromide concentrations recorded at the monitoring locations at SLC are stable or falling at most locations and much reduced compared with peak concentrations recorded during the period 2000 to 2009. At monitoring locations 082, 216 and 223 bromate concentrations continue to exceed the bromate RCS. In recent years bromate concentrations at locations 080, 081 and 083 typically are lower than the RCS. Bromide concentrations generally remain above the bromide RCS.

45. In Annex C_Crest, paragraph 50, the APs consider it beyond doubt there is no longer a significant source of bromate and bromide in the unsaturated zone at SLCourt. The Agency disagrees as there is not sufficient evidence to support this statement.

46. Potential factors controlling the concentrations result from a combination of: downward contaminant migration from the soil zone; flushing of contaminants from the zone of fluctuation; and dilution effects under higher groundwater conditions; together with lateral migration from inputs higher up gradient on the site. The contribution of each factor to concentrations is difficult to assess but the suggested falling trend since 2010 is not valid since there was a peak in concentrations at that time at many of the monitoring points.

47. Monitoring by the Agency before the First Notice was served started around the time of exceptionally high groundwater levels especially in the area of Sandridge, where groundwater flooding occurred in 2000/1. The APs have shown in Annex C_Crest paragraphs 14 to 31 and Table C1 that there is no simple relationship between concentrations and groundwater levels. Relationships may exist but time lag effects cannot be quantified and may obscure any correlation.

48. The Agency agrees with the APs at paragraph 27 of Annex C_Crest that there is insufficient evidence for lateral migration. It is, however, a potential mechanism to explain otherwise apparently random peaks.

49. At paragraph 30 of Annex C_Crest the APs query what was meant by "*movement of the plume*" at paragraph 47 of the CD:

47. Individual groundwater level peaks often show an associated low concentration as illustrated by bromide in Borehole 2 Figure L where the dilution effects are temporary and demonstrate neither long term changes in groundwater quality nor movement of the plume.

By "*movement of the plume"*, the Agency was referring to migration of bromate and bromide as opposed to likely dilution effects which are short-lived with no lasting effect on concentrations.

50. Therefore whilst there is no disagreement that bromate and bromide continue to enter groundwater at SLCourt, the Agency's view is that there is not a generally decreasing concentration trend.

51. The Agency agree with the APs' comment in Annex C_Crest, paragraph 31

> *. . . that groundwater levels will continue to fluctuate and do not disagree that there is potential for concentrations to rise temporarily at SLCourt in the future. The considered view of the APs based on detailed analysis is that if concentrations at SLCourt increase in the future the magnitude and duration of any increase in contaminant mass flux from SLCourt . . . is likely to be small . . .*

but the Agency would not go as far as saying that:

> *. . . the consequences on the evolution and distribution of contaminant mass in the groundwater plume is likely to be small.*

as there are too many unknowns and other potential factors.

Monitoring locations near to SLCourt

52. Paragraph 4.14 of Report F1 describes the apparent decline in concentrations in the zone near to SLCourt:

> *4.14 As shown on the figures presented at Appendix B bromide concentrations in 2000 to 2001 at locations 019 and 028 of approximately 7,000 µg/l and 5,000 µg/l respectively were recorded and in the years since the concentrations generally have been reducing steadily. In recent years bromide concentrations at locations 019 and 028 typically are similar to or slightly higher than the bromide RCS of 500 µg/l. A similar pattern of variation is observed in respect of bromate at locations 019 and 028 and bromate concentrations at both locations have reduced from a peak of more than 4,000 µg/l in 2000 to approximately 200 µg/l to 500 µg/l in recent years. For comparison and based on the monitoring database presented at Appendix A bromide concentrations were recorded on several occasions at locations 019 and 028 in the period 1984 to 1987. During this period bromide concentrations at location 019 ranged from 617µg/l to 7400µg/l and at location 028 ranged from 220µg/l to 2,200µg/l*.

53. Given the overall apparent stable nature of SLCourt concentrations, it is difficult to see how bromate and bromide within the plumes would be reducing in any long term fashion. The variable nature of the Chalk is described in Report F1, paragraph 8.22 as:

> *8.22 . . . discrete pathways such as a relatively small number of conduits enhanced by solution or in numerous pathways comprising an interconnected and widely distributed fracture network occupying a large volume of aquifer. . .*

This comment relates to uncertainty in the distribution of the contaminant mass but the same features can also cause a series of different flow and migration rates and hence time delays. The slowest rate is the diffusion in and out of the pore spaces. There may also be a range of different sized fissures forming the pathways within the Chalk affecting flow rates and migration. An added complexity is the vertical heterogeneity of the Chalk and the vertical profile of the bromate and bromide, so that contaminant concentrations are dependent upon which fissures are filled and hence where the majority of lateral flow takes place coupled with the potential for perched water tables (ephemeral or permanent) above the main body of groundwater.

54. The Agency now agrees with the APs that there is not evidence for groundwater levels being as dominant a factor as previously suggested but they may still place an important part along with abstraction rates and other variables.

55. The Agency's comparison between concentrations from the 1980s and more recent data, based on the data plotted in Figure O suggests values remain within a similar range; the decline described in Report F1, paragraph 4.14 is not borne out by the data. Bromide concentrations are plotted on a logarithmic scale in Figure O and show a number of features:

    i. the response shown near the start of the record at Nashes Farm and Cap's Cottage is likely to be due to demolition or redevelopment activity at SLCourt in the 1980s with a more subdued and later response at Orchard Garage;

    ii. the highest concentration at Nashes Farm in the 1980s is higher than that during 2000/1 but the lowest value at Nashes Farm in the 1980s is lower than current low levels;

    iii. it is possible that the Nashes Farm monitoring point may have been influenced by abstraction to a greater extent in the 1980s than it is now. However, overall there is not a clear indication of a significant reduction in the plumes over time; and

iv. Cap's Cottage (020) and Fairfolds Farm (018) are also shown on Figure O (see Figure E for locations). As with Nashes Farm, it is likely that more water would have been abstracted at these locations in the 1980s than it is now, since the groundwater is not currently being used as a drinking water supply.

56. It is worth noting that in this upper part of the plumes, apart from a couple of exceptions, 2018 groundwater levels have been at their lowest since sampling recommenced in 2000.

57. An examination of the ratio between bromate and bromide concentrations (bromate:bromide ratio) rather than the individual contaminants provides information which is less influenced by changes in groundwater level, for example dilution. For much of the time, Orchard Garage and Nashes Farm bromate and bromide concentrations are the same order of magnitude, as shown in Figures M and N. The marked differences between concentrations at the two locations are shown by the bromate:bromide ratio graphs for the two locations in Figure P. Peaks occur at each location on a somewhat cyclical pattern with a cluster of bromate:bromide ratio peaks (indicating a high bromate concentration relative to bromide concentration) approximately every 8 years. At both locations, some of the bromate:bromide ratio peaks occur at short term groundwater lows. The magnitude of these peaks appear to be decreasing at Orchard Garage but increasing at Nashes Farm. The simplest explanation for this is that the peaks reflect the different geographical locations of the bromate and bromide sources at SLCourt and that at Orchard Garage and Nashes Farm the bromate and bromide plumes still retain their separate identities However, this is by no means certain.

58. The APs comment in Annex_B Crest at paragraph 54 that the above observations do not merit detailed consideration. The Agency agrees but it is included as a further illustration of how little is understood about the contaminant plumes.

59. In conclusion, following consideration of the additional information provided by the APs' in their consultation response, the Agency agrees that there is insufficient evidence for some of the ideas it put forward, particularly a simple relationship between groundwater levels and contaminant concentrations. The Agency agrees that the APs conceptual model is reasonable in theory but in practice it lacks sufficient evidence to support it.

60. The APs suggest in Annex C_Crest, paragraphs 39 to 44 that the concentrations in groundwater at SLCourt have reduced by one to three orders of magnitude since the 1980s. The EA agrees that groundwater concentrations for bromide have reduced but not by the orders of magnitude stated because there are a number of factors which make the STATS

borehole data disproportionately high. These are explained in the Agency's comments on Annex C_Crest, paragraphs 61 and 62 below.

61. In paragraphs 45 to 50 of Annex C_Crest, the APs review information available on the contaminant mass in the unsaturated and saturated zones at SLCourt. The Agency agrees that it is likely that much of the contaminant has moved off-site but any quantification is difficult because of the uncertainties in the estimates of contamination on site. The groundwater concentrations on site indicate that it is likely a significant source still remains in the unsaturated zone.

62. Paragraphs 51 to 60 of Annex C_Crest provides a comparison of contaminant input and output mass flux in the groundwater plume. Paragraph 56 assumes contaminant mass removed between 1980 and 2000, as an indicative measure only. It is useful. However, the quantities removed are very much greater than the estimates of contaminant on site. This raises a question about the reliability of the on-site estimates which may be greatly underestimated. However the conclusions in paragraph 58 of Annex C_Crest are helpful and given the Agency's view of the data, that SLCourt contaminant concentrations are remarkably stable overall, it is quite possible that much of the contaminant is within the porewater. On this basis, it will continue to be present for a very long time, without discernible reduction unless remedial action is taken.

63. In accordance with paragraph 59 of Annex C_Crest, the Agency agree that the centre of the mass of the fissure flow component of the plume is moving down gradient, it is the rate at which it is happening and where it is located currently which is unknown.

64. The calculations provided in paragraphs 60 and 61 of Annex C_Crest do not consider pumping from specific horizons to increase the amount of contaminant removed for a given volume of water abstracted. Nor do they consider alternative methods for disposing of the abstracted water which would allow for the removal of larger volumes.

65. The comparison presented at paragraph 62 of Annex C_Crest shows that Bishop's Rise is the most effective single point for scavenge pumping but this does not actively remediate the aquifer in the area of the upper part of the plumes.

66. At paragraphs 63 and 64 of Annex C_Crest the APs summarise their position. Contrary to the APs' comments, the Agency have not specified the nature of the scavenge pumping or that it must take place at Orchard Garage. The relevant assessment actions have been re-written to make clear the flexibility in approach intended.

67. At paragraphs 65 to 68 of Annex C_Crest the APs compare costs of bromate and bromide removal at Bishop's Rise compared with another scavenge location and conclude that there would not be significant benefit and that it would not be cost effective. However, remediation at another location could be carried out in a number of different ways some of which could be very different from that at Bishop's Rise.

Hatfield Quarry

68. Hatfield Quarry is an extensive area of gravel extraction and landfill down hydraulic gradient from SLCourt. It has groundwater monitoring boreholes, some of which are monitored by the APs. There are five at Hatfield Quarry and three at Symondshyde Farm as listed in Table A and shown on the map at Figure E.

69. Report F1, 4.22 refers to concentrations at boreholes 166 (WPG16) and 061 (WM4) (see locations on Figure E) in the vicinity of Hatfield Quarry as highly variable but no explanation is given:

> *4.22 At monitoring location 166 bromide concentrations have been highly variable since 2000. Bromide concentrations in the range 1,500µg/l to 2,500µg/l and bromide concentrations below the bromide RCS are recorded commonly. There may be a slight decreasing trend in bromide concentrations at location 166. At monitoring location 061 bromide concentrations recorded generally decreased from around 800µg/l in 2000 to around 400µg/l in 2008 to 2010 which is less than the bromide RCS. Since 2011 bromide concentrations at location 061 have been increasing steadily and since 2016 the bromide concentrations recorded typically are in the range 1,200µg/l to 1,300µg/l.*

That some are increasing and others decreasing may suggest not a general decline but other factors at work such as a sideways movement of the plumes, possibly associated with variation in pumping rates at Bishop's Rise. Recent changes are unlikely to be due to quarry dewatering since this is now managed with the contaminant plumes in mind.

70. The second bullet point of paragraph 4.34 describes concentrations between SLCourt and Hatfield Quarry:

> *4.34 Based on the review of the plume monitoring data:*
>
> *. . . Between SLC and Hatfield Quarry the bromate and bromide concentrations in recent years are significantly lower than the*

peak concentrations recorded since 2000. Where concentrations of bromate and bromide remain above the respective RCS generally they are only slightly elevated compared with the RCS or are reducing steadily.

However, at Nashes Farm for example, although concentrations are going down they are very much higher than the RCS.

Summary of contaminant migration up hydraulic gradient of Bishop's Rise

71. Potential contributory factors for an apparent decline include:

(i) Variation in abstraction rate at monitoring points.

(ii) Frequency of recharge events that lead to contaminant dilution away from source areas. These are short-lived events but frequency may influence an apparent trend.

(iii) Secondary sources of contamination, within saturated or unsaturated aquifer as discussed in paragraphs 23 to 29.

(iv) Inter-actions between any of the above.

(iv) Down hydraulic gradient of Bishop's Rise

72. Turning to the lower part of the plumes, data from January 2009 to 2018 down hydraulic gradient of Bishop's Rise show increasing concentrations of both bromate and bromide. This includes the non-pumped locations: Arkley Spring (288) and Lynch Mill Spring (382). The Agency view is that the primary reason for the concentration increases is the reduced abstraction rate from Bishop's Rise in recent years.

73. NNR well locations are listed in Table A and shown on Figure C, together with the 5 year mean (01/2013 – 12/2017) bromate and bromide concentrations. Concentration trends are shown on the graphs provided in Appendix B of Report F1. The steepest increase occurs at Broxbourne. Most of the NNR wells show 5 year average bromate concentrations in excess of the drinking water standard of 10 µg/l and three locations exceed 20 µg/l. The highest concentrations are seen at Hoddesdon. The 5 year average concentrations of bromide at each of the NNR wells is around 150 µg/l which is below the RCS.

74. Agency comments on Report F1 in relation to the lower part of the plumes are given under four headings, regarding three locations: Essendon, Bishop's

Rise, NNR wells, and the scatter plots. Scatter plots graphically illustrate the relationship between variables. Values are plotted for two different variables as determined by the x- and y-axes.

Essendon

75. Report F1 paragraph 4.29 describes bromide peaks at Essendon as outliers or "spurious":

> *4.29 At Essendon (location 143) bromide concentrations generally are recorded below the RCS at approximately 150µg/l with the exception of isolated concentration spikes which it is considered may be spurious. Since about 2013 bromide concentrations may be increasing. At Essendon the recorded bromate concentrations generally are significantly higher than the RCS in the approximate range 20µg/l to 50µg/l and have been increasing from around 2013. Further information on the trends observed at Essendon is presented in Table 2.*

The Agency disagrees that these are spurious since past monitoring data shows isolated peaks at Essendon for a number of other contaminants.

Bishop's Rise abstraction

76. The Agency acknowledges the complexity of the contaminant concentrations in the groundwater and this includes the correlation between Bishop's Rise pumping rate and concentrations within down gradient boreholes. Paragraph 5.7 of Report F1 states:

> *5.7 Although based on Table 2 it is considered that the correlation between pumping rate at Bishops Rise and the concentrations at monitoring locations north east of Bishops Rise such as Essendon and in the NNR wellfield generally is not strong it is noted that there is particularly high variability in the concentrations recorded at a number of the monitoring locations when abstraction rates at Bishops Rise are low. It is typical that both the highest and the lowest concentrations were recorded at these locations when the Bishops Rise abstraction rates were low. It is possible that pumping at Bishops Rise causes mixing of groundwater which contributes to smoothing of the peaks and troughs in the concentrations observed at down hydraulic gradient monitoring locations including in the NNR wellfield.*

The Agency is unclear how pumping at Bishop's Rise causes mixing of the groundwater down gradient and what mechanisms are envisaged by the APs. In general terms, the Agency would expect any water mixed by the Bishop's Rise abstraction to be removed. However, one possible mechanism to achieve what is described in paragraph 5.7 is that the cone of depression due to abstraction may cause fissures at shallow depth to be above the water-table and become inactive.

77. The APs' clarification in paragraph 67, Annex B_Crest confirms that there is no disagreement between the Agency and the APs on this point.

NNR wells

78. The NNR wells are distant from Bishop's Rise but the influence of scavenging is critical. Paragraph 5.8 of Report F1 describes high contaminant removal rates in 2012 and 2013 and a significant reduction since 2014 at Bishop's Rise:

> *5.8 Contaminant mass removed from the aquifer at Bishops Rise will not reach the monitoring locations at Essendon or in the NNR wellfield and on this basis abstraction at Bishops Rise may reduce accordingly the peaks in bromate and bromide at certain monitoring locations at the NNR wellfield. Since 2010 the highest rates of contaminant mass flux removal at Bishops Rise were in 2012 to 2013 when approximately 2000g/day of bromate and 7000g/day of bromide was being removed. Mass flux removal at Bishops Rise reduced significantly from 2014 to 2018. In early 2018 the mass removal rate for bromate and bromide is around 400g/day and 1000g/day.*

Higher abstraction rates at Bishop's Rise from 2012 to 2014 is the main reason for the highest contaminant removal rates mentioned above.

79. Paragraph 5.9 states:

> *5.9 . . . As pumping rates at Bishops Rise were low generally in 2017 and remained at less than 1Ml/day in the first part of 2018 it is considered that pumping rate at Bishops Rise is not the primary influence on concentrations at the NNR wellfield in the short term. However this does not rule out abstraction at Bishops Rise having a long term benefit in reducing concentrations or reducing the variability in concentrations of bromate at the NNR wellfield as described above.*

There is insufficient evidence to state that pumping rates are not the primary influence on concentrations at the NNR wells in the short term. The complexity of groundwater level changes and variation in recharge rate,

together with time-lag effects make it difficult to ascertain the contribution from each variable. The longer record indicates the effectiveness of abstraction at Bishop's Rise. As the Inspector noted in relation to the case for TWUL (IR349-350), abstraction at Bishop's Rise leads to a rapid decrease in contaminant concentrations at the NNR wells and the converse is true:

IR349 Results to date, from the Hatfield trial, clearly demonstrate a beneficial impact on the NNR wells in reducing and controlling bromate levels. Concentrations at the affected NNR wells show a rapid decline when Hatfield pumping is initiated and concentrations thereafter are maintained at a lower level than would be expected without Hatfield pumping.

IR350 A study of the Hatfield testing has identified a statistically significant relationship between Hatfield abstraction rate and bromate concentrations at the affected NNR wells and at TVW's Essendon source; further tests would be needed to separate out the effects of parameters affecting aquifer recharge, but the dominant influence on these downstream bromate levels is the abstraction rate. No countervailing statistical analysis has been produced by the appellants, in particular Redland. This study has been assessed and verified by an external expert, who concluded that maximum bromate removal (and lowest bromate concentration at the NNR wells) was achieved by pumping at the highest rate allowed by the license. The fact that Hatfield has such a beneficial impact is only a surprise in respect of the rapid nature of the decrease in bromate concentrations seen; this is assumed to reflect the dominant and rapid fissure flow between Hatfield and the NNR wells. The fact that Hatfield acts as an effective scavenging point fits with a conceptual model of the bromate plume where, prior to ceasing abstraction for public water supply in 2000, Hatfield was acting to minimise the migration of bromate hydraulically downgradient. Between 2000 and 2005, when Hatfield was not pumping, more of the bromate contamination was allowed to migrate hydraulically downgradient resulting in the rising bromate concentrations seen at the NNR wells and at Essendon. On reinitiating pumping in 2005, the rising trend in concentrations downgradient was stopped. This fits with a conceptual model which has a stable steady-state plume upgradient of Hatfield and a more dynamic situation downgradient.

As abstraction is the only variable that can be controlled, it is a crucial one to optimise. NNR well (see Figure C for locations) concentrations have risen during 2017 when scavenge pumping volumes have been of the order of only

1Ml/day and were even lower at the start of 2018, as described in section 5.9 of Report F1.

80. Report F1 paragraph 5.10 states:

> *5.10 Based on the changes in the distribution of concentrations of bromate and bromide described in section 4 of this report and on the assumption that the centre of contaminant mass in the plume is migrating further down hydraulic gradient with time, it is not unexpected that concentrations at certain down hydraulic gradient monitoring locations would increase with time. Rising trends in bromate concentrations typically became established during the period in the mid to late 2000s when pumping rates at Bishops Rise were high and before the sustained recession in groundwater levels and reduction in pumping rate from 2014.*

81. Paragraph 72 above describes the current rise as starting in about 2009. Report F1, Appendix B graphs also show a rising trend starting in around 2003 at many locations down gradient of Bishop's Rise, earlier than described in paragraph 5.10. Arkley Spring is a good example to take since this monitoring point is unaffected by pumping. The 2003 rise could be a consequence of the period when no abstraction was taking place at Bishops Rise in the early 2000s. In the Arkley Spring example and elsewhere, concentrations are largely decreasing again by 2005, consistent with the recommencement of pumping at Bishop's Rise (see IR350, paragraph 79 above).

82. As mentioned in paragraph 5.11, the groundwater plume is a complex dynamic system:

> *5.11 The groundwater plume is a complex dynamic system in which multiple influences which vary in space and time will have a bearing on the concentrations of bromate and bromide recorded in individual boreholes. . .*

The effect of the scavenge pumping to date is indeed masked by the multiple influences as described at paragraph 69 above.

Scatter plots

83. Scatter plots of: concentration versus groundwater level are presented in Appendices C and D of Report F1 for bromate and bromide, respectively; and concentration versus abstraction rate at Bishop's Rise are in Appendices J and K for bromate and bromide, respectively. These are discussed further in paragraphs 74 and 75 below. Appendices H and I (bromate and bromide respectively) include colour to indicate different time periods. Appendices L

and M (bromate and bromide respectively) plot abstraction at monitoring points against concentration and use colour to indicate different pumping rates at Bishop's Rise. Yet these further two sets of analyses using a third variable do not show relationships that are any clearer than those of the first two sets.

84. As described in Table 2 of Report F1 and summarised in paragraph 5.7:

> *5.7 Although based on Table 2 it is considered that the correlation between pumping rate at Bishops Rise and the concentrations at monitoring locations north east of Bishops Rise such as Essendon and in the NNR wellfield generally is not strong. . .*

There is little correlation between concentration and abstraction rate. In the Agency's view, there are a number of potentially straightforward reasons for this:

i. the time lag between changes in Bishop's Rise abstraction rate and contaminant concentrations;

ii. abstraction rates at the monitored locations, Essendon and NNR wells;

iii. confined Chalk groundwater giving rise to reducing conditions in part of the aquifer for at least some of the time between Bishop's Rise and NNR wells which may allow some conversion of bromate to bromide within the aquifer;

iv. scatter plots show isolated points in time without reference to preceding abstraction rates and therefore each point has no context associated with it.

85. Likewise, for most monitoring locations Table 2 of Report F1 states there is no clear relationship between concentration and groundwater level. Similar reasons to those given in paragraph 74 for no clear trends in the scatter plots may apply:

i. the time lag between groundwater level change and contaminant concentrations;

ii. confined Chalk conditions in part of the aquifer for at least some of the time between Bishop's Rise and NNR wells;

iii. plots show isolated points in time without reference to previous groundwater levels and therefore each point has no context associated with it.

86. For this last reason in each case (74 iv and 75 iii), the Agency view graphs of concentration against time, overlaid with abstraction rate and/or groundwater levels against time as a more useful means of assessment than scatter plots in this instance.

(iv) Concluding Remarks on Contaminant Migration

87. Based on the evidence that is currently available, the Agency does not accept the suggestion in Report F1 that there has been a long term decreasing trend in the concentrations of the relevant contaminants in the upper part of the plumes, and a persistent increasing trend in the lower part, consistent with a migrating plume. There are other explanations for the changes in concentration that have been observed to consider. These explanations include factors, individually or in combination, such as abstraction rates and groundwater levels. The mechanisms acting in the upper part of the plume may not be the same as those acting in the lower part. The additional analysis in the APs consultation response leads the Agency to accept the plume is not only spreading but that the centre of mass of the more rapid, fissure flow component is also migrating down gradient. However the rate at which this is happening and where it is located currently are unknown.

88. Therefore the Agency's position is that at present there is insufficient evidence to conclude that scavenge pumping up gradient of Bishop's Rise would not be worthwhile in addition to scavenge pumping at Bishop's Rise itself.

3. Remediation options

89. Assessment work has been carried out and reported in Report F1 but this is not conclusive and other alternatives put forward in *Report D,* paragraphs 2.5 and 2.7 and Figure 1 still cannot be dismissed with any confidence. Report D states:

> *2.5 For potential single abstraction location candidates that are near to the centre line of the bromate and bromide plumes are preferred. A number of existing boreholes which are located close to the approximate centre line of the plume are shown on Figure 1. Based on the review of abstraction locations it is considered that potentially suitable locations for abstraction from a single point in order of preference are Orchard Garage (monitoring location 028), Harefield House (226) and Hatfield Quarry (067) . . .*

2.7 Abstraction from an array of boreholes rather than from a single location has the advantage that:- 1, it minimises the possibility that fracture networks are not intercepted by the abstraction scheme; and 2, provides a distribution of the boreholes across part of the plume and 3, facilitates pumping at a lower rate than would be the case for abstraction from a single location. The preferred arrays generally comprise two to three boreholes with an array closest to St Leonard's Court being preferred. The closest potentially suitable array comprises boreholes 028, 226 and possibly a new borehole located in the vicinity of NGR 179 102 (referred to as Group 1). A more distant potential abstraction array comprises boreholes either at or in the vicinity of boreholes 068, 067 and 065 in the vicinity of Coopers Green Lane (Group 2). The closest array (Group 1) comprises locations which are monitored routinely hence replacement monitoring boreholes may be needed if these locations are used for abstraction. Consideration was given to other arrays located between the Group 1 and Group 2 arrays but these were not selected due to the presence of potential alternative sources of groundwater contamination or the absence of road infrastructure hence limited ease of installation of a sewer connection.

90. Report F1, paragraph 8.3 mentions improved bromate and bromide removal through the use of an array of scavenge pumping boreholes rather than just one at Orchard Garage:

8.3 The pumping trial at Orchard Garage has identified that a groundwater abstraction well could be operated at a constant abstraction rate of approximately 0.5Ml/day subject to suitable arrangements being put inplace for the dealing with the abstracted water. More than one abstraction well may be needed to provide an array to facilitate the efficient removal of contaminated groundwater. The mass of bromate and bromide that could be removed from abstractions at this location is shown in Tables 6 and 7. As shown in Table 6, approximately 220g/d of bromate potentially could be removed from an array boreholes operating at an abstraction rate of 1Ml/day. . .

Further, an array encompassing other possible locations in the vicinity of Orchard Garage is described at paragraph 8.6 which refers to an array across the plumes:

8.6 If scavenging abstractions were to be installed in the vicinity of Orchard Garage, in order to achieve any meaningful abstraction regime it may be necessary to install at least two or three abstraction boreholes in an array across the width of the plume.

Indicative mass removal rates for possible configurations of abstracted arrays in the vicinity of Orchard Garage are presented in Tables 6 and 7. . .

Tables 6 and 7 in Report F1 only provide indicative mass removal rates for locations at Orchard Garage and Harefield House and do not include the wider range of possible locations referred to in Report D. Report F1 does not explain this change. The APs must explore this further and therefore the Second Notice includes Assessment Actions to follow this through.

91. Report F1 says it is unlikely, and the Agency agrees, that a sole location up gradient and preferable to Bishop's Rise will be found.

92. However, additional scavenge pumping location(s) may be beneficial in significantly reducing the contaminant mass within the aquifer, reducing the overall time period for remediation and hence reducing overall cost. Furthermore, scavenge pumping up gradient of Bishop's Rise may reduce contaminant concentrations sufficiently that treatment to potable quality can be undertaken at, or in the vicinity of Bishop's Rise at an earlier stage than would otherwise be feasible.

93. Action F1 requires one option to be chosen as the best practicable technique but this does not mean that option cannot be a combination of one of more of the individual options. The Action E report did consider the combination of individual options to form the best practicable technique:

> *2.8 Many of the remediation options presented in Table 1 include the removal of the pollutants from the soil or groundwater. In parallel to reviewing which remediation options are feasible it is necessary to assess the feasibility of the treatment options for the removal of the pollutants from soil or groundwater. The review of the options with respect to treatment are presented in Table 2. The remediation and treatment options can be combined in a number of different configurations and different configurations may be appropriate at different points in time. In Tables 1 and 2 the options which are not considered feasible are identified and will not be considered further. The options which are considered potentially feasible are being considered further as part of the work under Assessment Action F1.*

94. There is reference to scavenging at an appropriate point, or points, in Report F1, for example:

> *8.1 Based on the review of the potentially feasible remediation options set out in section 6 of this report, it is concluded that the potential options which may be practicable for the management*

of the Contamination associated with the site at SLC are:

- *The abstraction of groundwater at an appropriate point(s) in the plume of contaminants which achieves meaningful removal of contaminant mass and/or provides adequate protection to water supplies down hydraulic gradient of the scavenge location. This would be combined with the disposal of the abstracted groundwater directly or indirectly via the sewerage network to the surface water system with or without treatment. It is necessary to consider and identify the most appropriate location(s) for ongoing scavenge pumping together with the route(s) for disposal of the abstracted water*.

95. However, a combination of options to form the best practicable technique is discounted in Report F1. The reasons given for not pursuing several abstraction points are the practical difficulties similar to those encountered for the pumping trial at Orchard Garage and the hypotheses that the central mass of the contaminant plumes has migrated down gradient.

> *8.7 As evidenced by the time taken to prepare for the pumping trial despite the best endeavours of the APs, resolving all these constraints would be very time consuming and are unlikely to be achieved in the short term. Based on the observed monitoring data trends, by the time that the installation of abstractions might be achieved the concentrations of the contaminants in the groundwater will have reduced further and any benefit associated with contaminant mass removal at this location would be even less than currently.*

Regarding the first point, on the time taken to prepare, comment is made at paragraphs 33a and 33b of the main text. On the second point, the Second Notice is designed to show whether or not there should be additional scavenging locations up hydraulic gradient of Bishop's Rise and draws on the conclusions reached in this appendix.

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5. The Likely Duration of the Long term Remediation

96. In the current RBMP, an alternative objective which extends the deadline from 2021 to 2027 for the change from poor to good status for the two affected groundwater bodies is accepted. SLCourt is within the Mid-Chilterns Chalk and the plumes extend over 20 km covering a large part of the Upper Lee Chalk groundwater body as well. Although there are additional reasons why the groundwater bodies fail, the bromate pollution plume is the sole reason

why they do not pass the General Quality Assessment (or General Chemical Assessment). For details of the test see *UK Technical Advisory Group on the Water Framework Directive Paper 11b(i) Groundwater Chemical Classification for the purposes of the Water Framework Directive and the Groundwater Daughter Directive:*
https://www.wfduk.org/sites/default/files/Media/Assessing_the_status_of_the water environment/GWChemical Classification Paper_Draft_210607.pdf

97. The Agency's comments on the importance of the WFD are included in the main text. In paragraphs 69 to 77 of Annex C_Crest, the APs make detailed comments on the WFD status of the groundwater bodies, based on the Agency's RBMP. They reproduce information from the Agency's Catchment Data Explorer (CDE) at Appendix C8 but have not interpreted this correctly.

    The relevant information in the CDE relates to two groundwater bodies, the Mid-Chilterns Chalk and the Upper Lee Chalk. 'Reasons for Not Achieving Good' (RNAGs) sorted by the 'Classification Element' (the most right-hand column) are set out in the tables below. Full details can be found at:
    https://environment.data.gov.uk/catchment-planning/WaterBody/GB40601G601200
    and
    https://environment.data.gov.uk/catchment-planning/WaterBody/GB40601G602900
    respectively.

(i) Mid-Chilterns Chalk

98. The chemical drinking water protected area classification element failed during Cycle 2 due to twelve identified activities.

99. There are five RNAGs against the Chemical Drinking Water Protected Area element (Table 1). These are: sewage discharge (continuous), incidents, poor nutrient management, contaminated land and private sewage treatment works. Poor nutrient management is detailed twice because historically there were two different combinations of RNAGs which are no longer allowed, and both have been 'funnelled' into poor nutrient management. It should be noted that one of these is incorrect and will be updated in the CDE at the next opportunity.

100. The same activities are also impacting on the Trend Assessment. The inclusion of these against the Trend Assessment is not considered to be a duplication of information. It is an acknowledgement that the same pressures are impacting on this classification element as well.

101. Therefore, the interpretation by the APs of the information in CDE (regarding twelve identified activities against one element) is incorrect. Five different activities are impacting on two qualitative elements (Trend Assessment and Chemical Drinking Water Protected Area), with the poor nutrient management considered to be duplicates.

Reasons for not achieving good status and reasons for deterioration

Download as CSV

Reason Type	SWMI	Activity	Category	More	Classification Element
RNAG	Point source	Private Sewage Treatment	Urban and transport	Details	Trend Assessment
RNAG	Diffuse source	Contaminated land	Urban and transport	Details	Trend Assessment
RNAG	Diffuse source	Poor nutrient management	Agriculture and rural land management	Details	Trend Assessment
RNAG	Point source	Incidents	Urban and transport	Details	Trend Assessment
RNAG	Point source	Sewage discharge (continuous)	Water Industry	Details	Trend Assessment
RNAG	Diffuse source	Poor nutrient management	Agriculture and rural land management	Details	Trend Assessment
RNAG	Flow	Groundwater abstraction	Water Industry	Details	Quantitative Water Balance
RNAG	Flow	Groundwater abstraction	Water Industry	Details	Quantitative Dependent Surface Water Body Status
RNAG	Point source	Sewage discharge (continuous)	Water Industry	Details	Chemical Drinking Water Protected Area
RNAG	Point source	Incidents	Industry	Details	Chemical Drinking Water Protected Area
RNAG	Diffuse source	Poor nutrient management	Agriculture and rural land management	Details	Chemical Drinking Water Protected Area
RNAG	Diffuse source	Contaminated land	Other	Details	Chemical Drinking Water Protected Area
RNAG	Diffuse source	Poor nutrient management	Agriculture and rural land management	Details	Chemical Drinking Water Protected Area
RNAG	Point source	Private Sewage Treatment	Urban and transport	Details	Chemical Drinking Water Protected Area

Table 1. Mid-Chilterns Chalk

ii. Upper Lee Chalk

102. The chemical drinking water protected area classification element failed during cycle 2 due to fourteen identified activities.

103. An equivalent list of RNAGs to those for the Mid-Chilterns Chalk, are set out in Table 2 below. There are five RNAGs (poor nutrient management, contaminated land, incidents, sewage discharge (continuous) and private sewage treatment) against the Chemical Drinking Water Protected Area element, with a duplicate for Poor Nutrient Management. This duplicate will

be removed as it is considered incorrect (as above). The same activities are also impacting on the Trend Assessment element.

104. Therefore, the interpretation by the APs of the information in CDE (regarding fourteen identified activities against one element) for the Upper Lee Chalk is incorrect. Five different activities are impacting on two qualitative elements (Trend Assessment and Chemical Drinking Water Protected Area), with the poor nutrient management considered to be duplicates. There are also two activities considered to impact on the General Chemical Test element.

Reasons for not achieving good status and reasons for deterioration

Download as CSV

Reason Type	SWMI	Activity	Category	More	Classification Element
RNAG	Diffuse source	Contaminated land	Urban and transport	Details	Trend Assessment
RNAG	Diffuse source	Poor nutrient management	Agriculture and rural land management	Details	Trend Assessment
RNAG	Point source	Private Sewage Treatment	Urban and transport	Details	Trend Assessment
RNAG	Diffuse source	Poor nutrient management	Agriculture and rural land management	Details	Trend Assessment
RNAG	Point source	Incidents	Industry	Details	Trend Assessment
RNAG	Point source	Sewage discharge (continuous)	Water Industry	Details	Trend Assessment
RNAG	Flow	Groundwater abstraction	Water Industry	Details	Quantitative Water Balance
RNAG	Flow	Groundwater abstraction	Water Industry	Details	Quantitative Dependent Surface Water Body Status
RNAG	Diffuse source	Contaminated land	Urban and transport	Details	General Chemical Test
RNAG	Diffuse source	Poor nutrient management	Agriculture and rural land management	Details	General Chemical Test
RNAG	Diffuse source	Poor nutrient management	Agriculture and rural land management	Details	Chemical Drinking Water Protected Area
RNAG	Diffuse source	Contaminated land	Industry	Details	Chemical Drinking Water Protected Area
RNAG	Point source	Incidents	Urban and transport	Details	Chemical Drinking Water Protected Area
RNAG	Point source	Sewage discharge (continuous)	Water Industry	Details	Chemical Drinking Water Protected Area
RNAG	Point source	Private Sewage Treatment	Urban and transport	Details	Chemical Drinking Water Protected Area
RNAG	Diffuse source	Poor nutrient management	Agriculture and rural land management	Details	Chemical Drinking Water Protected Area

Table 2. Upper Lee Chalk

iii. Groundwater quality overview

105. The RNAGs listed are potential causes, so poor nutrient management, water industry sewage discharge, private sewage treatment are all possible reasons for elevated nitrate in groundwater. In general, the groundwater quality in much of the plumes is good, apart from bromate and bromide. This is illustrated by the analytical data provided in Appendix N of Report D3c.

106. In paragraph 74 of Annex C_Crest, the APs refer to the need to consider whether measures to achieve water body objectives are affordable. Whereas the APs have given some consideration to the cost effectiveness of options, they have not assessed whether various remedial options are cost beneficial or not. See paragraphs 63 to 63g of the main text for details.

107. Further, the Agency is acting in accordance with the 2012 guidance s.1.4(c) which states:

> *1.4 The overarching objectives of the Government's policy on contaminated land and the Part 2A regime are:*
>
> > *(a) To identify and remove unacceptable risks to human health and the environment.*
> >
> > *(b) To seek to ensure that contaminated land is made suitable for its current use.*
> >
> > *(c) To ensure that the burdens faced by individuals, companies and society as a whole are proportionate, manageable and compatible with the principles of sustainable development.*

6. Conclusion

108. Contamination is still entering the groundwater at SLCourt and the pollution of controlled waters remains significant. The Agency wants scavenge pumping at Bishop's Rise and monitoring to continue in the manner set out in the First Notice as a long term remedial action. The assessment actions in the draft Second Notice in the CD have been altered and clarified to take account of the responses to the consultation as far as is possible in line with the Agency's statutory duties. The further actions that are still necessary to determine the Best Practicable Technique are set out in the Second Notice.

APPENDIX 3
Consultation Responses submitted by parties other than APs and WCos

Agency response identification	Consultation response text	Agency comment
ANON-BWF1-MQKS-C	*Bromate BRO3 is a slow-moving ion, so it is difficult to extract from the chalk aquifer. By tracking its path through the chalk aquifer – generally in a S.E. direction -it may be possible to force its extraction using the pump & treat method. _____Nicholas P. Cheremisinoff Ph.D.* *A network of intercepts, pump & treat boreholes, targeted at the most intense parts of the plume will reduce the contaminate faster and more efficiently than only one at Bishops Rise PWS Hatfield.* *A computer simulation of the plume would be a useful tool to position the extraction boreholes in the best possible location. By mapping we can get an idea of the amount of bromate salts left in the plume and the amount to extract. So far, we have only extracted 4 ½ tons of bromate at Bishops Rise in 15yrs.* *To prevent unbalancing the delicate aquifer conditions during this extraction process it is imperative that no inclusion into the aquifer happens - this inclusion includes digging, drawing groundwater off and quarrying to the lower mineral horizon.*	The Agency acknowledges the concerns of this respondent. We agree that much of the bromate is slow moving but this is because of the nature of the Chalk rather than the ion itself. The Second Notice includes actions to investigate remedial actions including pump and treat techniques. See the main text for details of the changes made following the consultation. Although not a matter for the Second Notice, we share the concern regarding activities above the plumes and will work closely with the planning authorities to ensure new developments will be carefully managed so that existing groundwater contamination can be mitigated against and will not be exacerbated.
ANON-BWF1-MQKC-V	*At a meeting of Full Council held on February 13th, Sandridge Parish Council resolved that I write to request that treatment continues beyond the proposed deadline of July 2019. It is requested that treatment continues until the contamination has been eliminated beyond any doubt.*	We agree with the need for continued treatment of the groundwater pollution. See the main text for details.
ANON-BWF1-MQKJ-3	*10 years of scavenge pumping have removed some of the bromate. The approach is extremely cautious in requiring costings and a four month time allowance before a further scavenge operation is required. Since Redlands and Crest are going to pay for this, what's the point in delay? The Orchard site should have converted to scavenge ages ago. And all sites well over the WHO limit should commence this. You are dealing with the biggest bromide spill in Europe- if scavenge pumping is all we have then it should be used to maximum effect. Just select a point at which it is unacceptable for a water source to have bromide - say 5 times the WHO limit and say that this means it has to be taken out of the supply system and converted to scavenge pumping*	Requirements for remedial action must meet the test of reasonableness which includes practicability and cost effectiveness (2012 Guidance). See the main text for details of the changes to the Second Notice the Agency have made following the consultation.
ANON-BWF1-MQKP-9	*I represent residents in Hatfield Villages ward, and Hatfield North Division of Hatfield. I have studied the documents you have provided on the website and I met with Affinity Water, in June 2018 regarding the risk to disturbing the Bromate plume which the methods which Brett have proposed to use to quarry in the Ellenbrook fields area of the Business Park. This is called the "Aerodrome quarry " in the Mineral plan consultation*	Although not a matter for the Second Notice, we share the concern regarding activities above the plumes and will work closely with the planning authorities to ensure new developments will be carefully managed so that

Agency response identification	Consultation response text	Agency comment
	of HCC. I believe this quarry should be suspended from the Mineral plan, on the grounds of the "precautionary principle" , given there is another far safer site for quarrying in Hertfordshire, with an equal or more volume of sand and gravel available. *As a result of our meeting in June 2018 , Affinity Water raised an objection to the "Aerodrome quarry" in August 2018 . I and my residents are concerned how far the Bromate plume has spread to Essendon, Ware, and into the River Lee. Also that the concentration of bromate under Hatfield exceeds the WHO limit for drinking water in many of the boreholes across the Hatfield Business Park despite scavenge pumping at XXX for 10 years. Indeed the Bromate concentration in XXX itself appears undented after 10 years .* *This appears to be the worst Bromate spill currently in Europe, and we believe there should be 3 simultaneous scavenge pumping sites in order to try to remove the amount of Bromate which appears to still be contaminating the chalk aquifer at St Leonard's court.* *We believe the 3 sites should be at Orchard Grange, Woodcok Hill, next door to Astwick Manor on Copper Green Lane (where there are available sewers) and at XXX as before .* *I would support the case for using the site on the Business Park (in North Ellenbrook fields) next to Astwick Manor for remedial pumping to extract the bromate from the water.* *These sites have been chosen because the bromate appears to more concentrated at the boreholes nearby to these sites , or pumping has already been started there . We hope this will acheive the remediation needed to decontaminate our water in the chalk aquifer over the next 10 years . EA should be given research expertise, to know the best method of remediation (including other possible chemical methods) to remove the Bromide and Bromate and to protect our precious water supply for Hatfield, for the future.*	existing groundwater contamination can be mitigated against and will not be exacerbated. See the main text for details of the changes made following the consultation.
BHLF-BWF1-MQKW-G	*Thank you for forwarding a copy of this consultation to the Centre for Radiation, Chemical and Environmental Hazards of Public Health England (PHE) on 8 January 2019.* *Having reviewed the St Leonard's Court Consultation Document Part I and Part II, PHE has no specific comments to make regarding the actions and assessments included in the proposed remediation notice.* *PHE would welcome the opportunity to comment on the potential impacts on human health and drinking water quality, if requested.*	We acknowledge the content of this response. We do not see a reason to consult further with Public Health England at this time but will contact them if necessary regarding matters within the Agency's remit.
BHLF-BWF1-MQKH-1	*Thankyou for the opportunity to respond to this consultation, which sets out the intended decision of the Environment Agency to issue a second remediation notice in respect of land at St Leonards' Court, and the contents of that notice.*	We interpret the recommendation for an additional monitoring borehole to be one installed at or near the existing scavenge pumping site in Hatfield. See the main text for our response.

Agency response identification	Consultation response text	Agency comment
	This is the response from Hertfordshire County Council's Public Health service, following discussion with the County Council's Environment Department in its capacity as Flood Authority and Minerals Planning Authority. *In summary, we have no objection to the proposals outlined in this consultation. More specifically, there are a number of outlined proposals which we consider to be a sensible and pragmatic approach, and we support the conclusion that scavenge pumping at XXX continues in its current form with the addition of a further borehole for monitoring purposes.* *Both the County Council and the Environment Agency are well aware of several matters of public concern in relation to the bromate and bromide contamination of the chalk acquifer in the Hatfield vicinity. We are satisfied that the scope of this consultation and subsequent remediation notice is not intended to address specific concerns around risks to drinking water, and proposals for quarrying activities in the local area.* *We note that Publlic Health England have responded with no specific comments regarding the proposed remediation notice, but that they would welcome an opportunity to engage in further dialogue with regards drinking water – which we support.*	
BHLF-BWF1-MQK2-B	*The Council welcomes the Environment Agency's consultation regarding the service of a second Remediation Notice with respect to groundwater pollution emanating from St Leonard's Court, Sandridge.* *This location falls within the St Albans City and District and it was the Council, with the assistance of The Agency and Three Valleys Water, who designated St Leonard's Court as Contaminated Land under Part IIA of the Environmental Protection Act 1990 on 20th June 2002. The Agency took over enforcement responsibility on 8th August 2002 following its further designation as a 'Special Site' (EPA 1990, Part IIA) due to the groundwater contamination.* *The Council supports The Agency's service of a second Remediation Notice on the 'Appropriate Persons' Crest Nicholson Residential PLC and Redland Minerals Limited.* *It is clear from The Agency's consultation summary of the Planning Inspectorate's public inquiry report (23rd November 2007) and subsequently The Secretary of State's appeal decision (22nd July 2009) upholding The Agency's first Remediation Notice (served 8th November 2005), that it was always envisaged a further Remediation Notice or Notices would be required unless the issue resolved itself. The first Remediation Notice consisted of assessment actions and interim scavenge pump mitigation to manage the bromate and bromide pollution downstream of the source.* *The Council notes the service of further Remediation Notices is permitted under The Secretary of State's EPA 1990, Part IIA Contaminated Land Statutory Guidance, April 2012.* *The Council agrees with The Agency in it seeking to maintain the current interim scavenge pumping mitigation from Affinity Water's XXX pumping station following the expiry of the existing (first) Remediation Notice on 22nd July 2019. It also supports the*	The request for confirmation of the locations and monitoring frequency of any further groundwater monitoring to take place on land owned/managed by the Council in acknowledged. We also acknowledge the value of early discussions on the need for any consents, such as planning permission from SADC. Further, the Agency acknowledges with thanks the offer of assistance from SADC regarding the Second Notice.

Agency response identification	Consultation response text	Agency comment
	investigation and implementation of further remedial actions to speed up remediation of the pollution. *The Council notes both Crest Nicholson Residential PLC and Redland Minerals Limited continue to voluntarily monitor the groundwater despite the requirement for this expiring in 2015.* *The Council is in agreement for further monitoring of the groundwater to take place on land owned/managed by this Council. When the ongoing monitoring locations are finalised, please could The Agency notify the Council so we are aware of the locations and monitoring frequency.* *We would welcome early discussions on the need for any consents, such as planning permission, from this Council for any potential treatment works or locations for additional scavenge pumping within our area.* *The Council will assist The Agency regarding this matter as it is able to do so.* *Thank you for your consultation on this matter.*	
BHLF-BWF1-MQKG-Z	*Please accept the following response from Welwyn Hatfield Borough Council (WHBC) to the above consultation. This response is an officer level response from the Directorate of Public Protection, Planning and Governance, and incorporates the views of both the planning and public health teams:* *We have no planning objections to the continued remediation strategy proposed by the Environment Agency, and would support the strategy detailed in that it seeks to monitor and reduce the levels of bromate and bromide pollution of the groundwater within Welwyn Hatfield. It is expected that the location and operation of monitoring boreholes within Welwyn Hatfield will be agreed by the Environment Agency with the relevant landowners as previously.* *Where new housing or other development involving significant excavation, or likely to impact groundwater, is being considered on land above the bromate plume the local planning authority will want to consult both the Environment Agency and WHBC Public Health team, to ensure that existing contamination can be mitigated against and will not be exacerbated.* *Public Health and Protection at WHBC support the decision of the Environment Agency to serve a second remediation notice and the associated actions required within the notice.* *WHBC is aware of a number of private water supplies, and provides information within this response to ensure that any actions bear in mind the risks of the bromate plume to these supplies;* *Regulation 9 Supplies – Large supplies & supplies as part of a commercial or public activity* *XXX, Welwyn Garden City, Hertfordshire , XXX*	Although not a matter for the Second Notice, we share the concern regarding activities above the plumes and thank Welwyn Hatfield Borough Council for wanting to consult the Agency on development proposals to ensure that existing groundwater contamination can be mitigated against and will not be exacerbated. Thank you for the information regarding private supply locations so these can be taken into consideration. To this end, the Second Notice includes two monitoring locations at existing boreholes in Hatfield Quarry in addition to those of the First Notice.

Agency response identification	Consultation response text	Agency comment
	XXX, Hatfield, Hertfordshire, XXX *XXX, Welwyn , Hertfordshire, XXX* *XXX, Woodcock Hill, Hertfordshire, XXX* *Regulation 10 Supplies – other private supplies* *XXX, Potters Bar , Hertfordshire, XXX* *XXX, Hammonds Lane, Hatfield , XXX* *XXX, Newgate Street Village , Hertfordshire, XXX* *XXX, Welwyn Garden City, Hertfordshire, XXX* *XXX, Welwyn Garden City, Hertfordshire , XXX* *XXX, Hatfield, Hertfordshire, XXX* *XXX, South Mimms, Hertfordshire, XXX* *XXX, Brookmans Park, Hatfield, Hertfordshire, XXX* *XXX, Hatfield , Hertfordshire, AL9 6DW* *XXX, Newgate Street Village , Hertfordshire, XXX* *XXX , Brookmans Park, Hatfield , Hertfordshire, XXX* *XXX St Albans , Hertfordshire , XXX* *In addition to this, the provision of the details of these supplies, if not already known by the Environment Agency, should help inform their responses for proposed developments at the proposed Hatfield Quarry site and development adjacent to the Hatfield Business Park which may, in relation to the bromate plume, have an impact on the supplies listed above.* *Please do not hesitate to contact Simon Chivers in the first instance if you have any queries in relation to this consultation response.*	
CR HCC RE	*From an estates perspective I have no comment except the below:* *We would be willing to grant an extension till 2029 on the same basis as your existing agreement.* *I am not sure if this could be done by alteration to the current one or whether it would require a surrender and regrant, either way we would appreciate our legal costs were covered.* *I trust that this does not sound unreasonable.*	The loss and damage for which compensation is payable is set out in paragraph 4 of schedule 2 to the Regulations 2006.
CR CEMEX	*Thank you for the consultation on the above. We have reviewed the document and it appears to affect CEMEX only in regard to the continuation of the monitoring of groundwater at CEMEX monitoring boreholes around the greater Hatfield Quarry area. CEMEX does not have any objection to this continued monitoring subject to the following*	We acknowledge with thanks the statement that CEMEX has no objection to continued groundwater monitoring by the APs subject to the requirements described.

Agency response identification	Consultation response text	Agency comment
	Anyone requiring to undertake monitoring must arrange the site visit in advance through the Hatfield Quarry manager, currently John Mawer (johnarthur.mawer@cemex.com). Please copy myself in so that should there be any change of manager the request can be relayed. *All personnel will adhere to CEMEX health and safety protocols, including PPE, and follow instruction from appointed site staff. The site manager will provide information on prevailing requirements* *Sampling teams will be competent in groundwater sampling and follow protocols to remove the opportunity for contamination of boreholes and cross contamination between boreholes.* *Could we also have the results of analyses please. Perhaps we can discuss and agree a format for these to allow easy transfer electronically.* *There are a number of reports referred to in the document. Are these all on the public register and is it possible to get electronic copies?*	The Second Notice has been amended from the draft consultation document to more explicitly identify Hatfield Quarry as a potential location that must be considered and assessed for long-term remediation. See the main text for details. We will provide monitoring results and reports whenever requested and according to our EIR / FOI. Most are available electronically.
P000051 / 21728	*Bidwells represents D'Arblay Investments who are the owners of the Orchard Garage site referred to in your consultation document. Our clients granted a temporary licence for water testing on the Orchard Garage site as part of its civic responsibility. The licence can be terminated by our client at any time.* *Our client strongly opposes any proposal that its land should be used in the longer term or on a more permanent basis, as such as it should not be considered as an alternative site. It will not be made available for such purposes.* *The Orchard Garage site is regarded in planning policy terms as previously developed land in the Green Belt and as such can be redeveloped. Following preapplication submissions Council Officers have confirmed the principle of residential redevelopment of this site is acceptable. Our client will be pursuing a residential redevelopment of the Orchard Garage site. At present a scheme for just the Orchard Garage site has been held back principally because a greater area of land (also within our client's ownership) was included in the Sandridge Neighbourhood Plan Consultation. In addition submissions have been made to the St Albans Emerging Local Plan for a larger residential development which includes not only the Orchard Garage site but land to the north owned by our clients.* *In summary our clients oppose Orchard Garage from being considered as an alternative location as it would be prejudicial to the residential redevelopment proposals which have been planned for the site and the principle of which has been agreed by the Planning Officers at the Council.*	Section 78G EPA states that any person whose consent is required for anything required by a remediation notice shall grant or join in granting such rights in relation to any relevant land or waters to enable an appropriate person to comply with a remediation notice. For more details see the main text. Following the responses from all consultees, the Agency has narrowed down, and now specifies four locations for the assessment actions. See the main text for details. The Agency makes no comment on the planning status of the property except to note that the 1994 Local Plan is still the relevant Local Plan as at 13 May 2019.