IAP Response

Ref B2.15.WSH.CE.A1

Revised Cost Adjustment Claim
Acceptability of Water

1 April 2019

Contents

1. Background

In our September Business Plan submission we set out our plans for expenditure on improvement of our acceptability of water performance in the 'Improving acceptability of water' cost adjustment claim [WSH-WN602001].

We have reconsidered the way that this expenditure was presented, and have now removed from the cost adjustment claim the expenditure related to network improvements. This expenditure is now covered by a separate investment case, as it falls under the scope of DWI legal notices. The investment case is included in our IAP submission as the Network Quality – New Legal Obligations investment case (Ref B2.16.WSH.CE.A1]). The activity in this area is principally our Zonal Studies programme.

Ofwat rejected the cost adjustment claim as "WSH did not identify a difference from other companies". However, we have further evidence of why we are different in relation to the causes of discolouration (the key driver of acceptability of water complaints), and we are presenting the remaining expenditure (less the Zonal Studies expenditure above) in this document.

This document covers activity on Taste, Odour and Colour improvement, amounting to £25m across three activity areas:

1. £16.8m of investment at treatment works and in catchments to reduce the level manganese entering the network;
2. £5.4m of enabling activities for the operational improvements in the network to be made in AMP7, and
3. £3.1m of investment to address 'worst served' customers who suffer repeated problems of discolouration (see Section 7).

This expenditure, particularly item 1 above, is vital in addition to the Network Quality programme in order to ensure all-round good value for money for customers. The network programme will address the immediate causes of discolouration that have built up in the network over time. However, unless the root causes of the problem are dealt with 'upstream' by permanently reducing the manganese entering the network, the network will require repeated expenditure in the future.

1.1. Ofwat's IAP feedback

A summary of Ofwat's IAP feedback on our original submission relevant to this cost adjustment claim, and how we have addressed that feedback, is provided in the table below.

IAP feedback	Response
Need for investment Lack of evidence of DWI support "WSH submitted a cost adjusment… We fail that claim as WSH did not identify a difference from other companies."	A response is presented in the new Network Quality – New Legal Obligations investment case. We present evidence on 'difference' from other companies as relevant to this cost adjustment claim in this document in Sections 2 and 3.
Management control "Sedimentation build-up in networks may be due to inadequate historical flushing regimes." [In response to the statement that we are failing to meet our AMP6 targets]: "This suggests that WSH was awarded enhancement spend in 2015-20 but is failing to deliver the expected benefit."	Not relevant to this claim. See Network Quality – New Legal Obligations investment case.
Best option for customers "Cleaning and mains replacement continues work from 2015-20 however failure to achieve targets in 2015-20 identifies that a change in approach is required."	Not relevant to this claim. See Network Quality – New Legal Obligations investment case.
Robustness and efficiency of costs. "Mains replacement: We select SWB as a comparator… On this evidence we consider that WSH has previously failed to invest in mains replacement consequent to asset deterioration and the proposed programme is driven WSH's need to catch up with the rest of the industry." "WSH present insufficient evidence of the scope of work at WTWs or that full optioneering has been completed for these schemes." "We find insufficient evidence that the worst served customers work is driven by TOC [taste odour and colour]. "	Not relevant to this claim. See Network Quality – New Legal Obligations investment case. We provide further evidence on scoping and optioneering in this document - see Section 6 below. We provide further evidence in this document. See Section 7 below
Deep dive analysis: Worst served customers "No further detail was provided such as size and location of clusters together with scope of work and options considered."	We provide further evidence in this document. See Section 7 below.

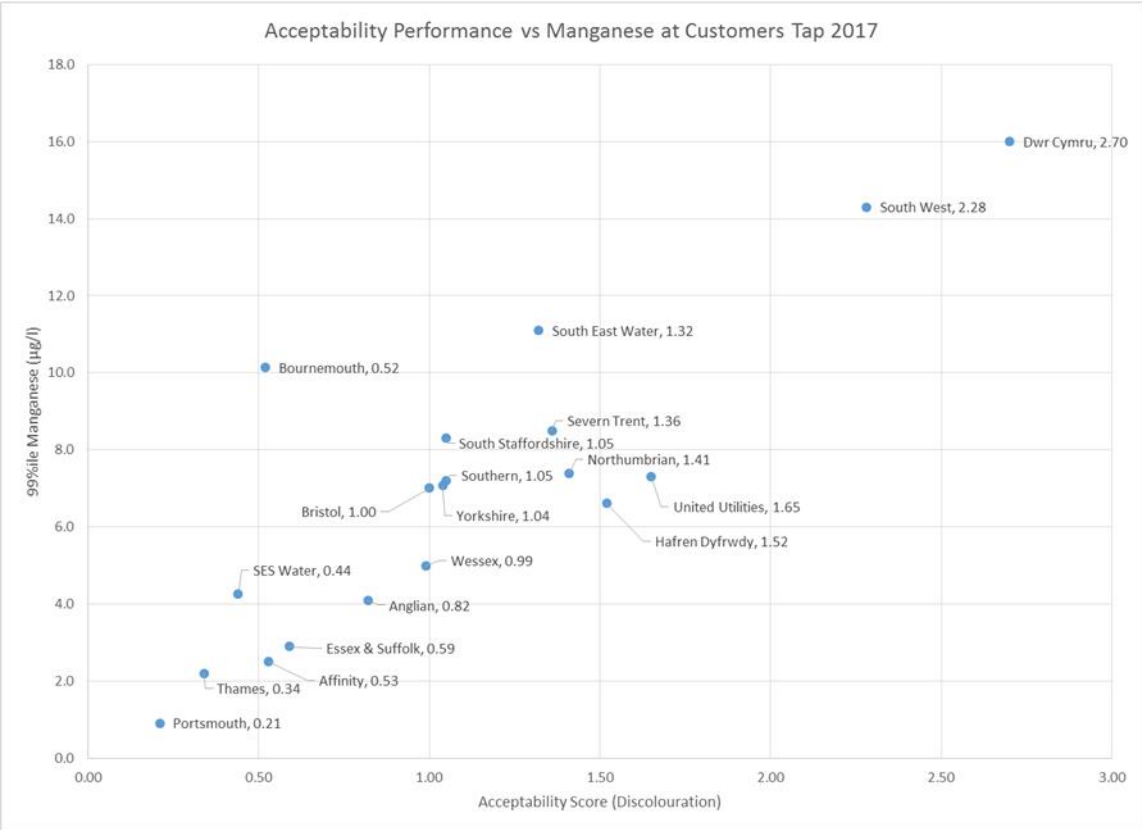
2. The causes of discolouration

This section describes the causes of discolouration in our network. These causes, and the associated features of our network, are different to those of other companies including South West. The optimal solutions are therefore different as well, undermining the legitimacy of comparing our costs with those of South West.

Thanks to the investigation work and the development of our Zonal Studies approach in AMP6, we now have a much better understanding of the causes of discolouration in our water supply systems.

2.1. Manganese as the root cause of discolouration of tap water

We now have hard data to demonstrate a direct relationship between manganese concentration in tap water and acceptability of water discolouration issues. A higher concentration of manganese in the network is more likely to lead to an increased volume of customer contacts.



The chart above shows the clear correlation between the level of manganese sampled at customers' taps and the number of discolouration contacts. Manganese levels appear to be a key driver of contacts due to discoloured water.

While the condition of our mains network and the way that we operate it do have an impact on our acceptability of water performance, the root cause of the problem can be traced back to the source water and the performance of water treatment works.

2.2. Manganese in catchments

The problem starts in the catchment with highly coloured, soft water. This is collected in impounding reservoirs located on geological formations where manganese is prevalent.

This chart shows the correlation across companies between the proportion of water supplied via impounding reservoirs and the level of manganese at the customer tap. We have a higher proportion of water supplied from impounding reservoirs than any other company.

2.3. Constraints to manganese removal at treatment works

The water treatment process requires removal of both organics (highly coloured raw water) and metals (primarily manganese). In simple terms, there is a trade-off between these two as removal of organics is optimised at low pH, whereas removal of manganese is optimised at higher pH. Adherence to water quality regulations means that we are required to focus primarily on the former, which then makes removing manganese more challenging, and subject to further investment.

The water then entering our distribution system is aggressive (i.e. has a tendency to corrode mains, making it more susceptible to discolouration problems), and has remaining manganese, albeit at low concentrations. This causes discolouration problems in the network as explained below.

2.4. How manganese causes discolouration

Cast iron trunk mains, which is the predominant pipe material in our areas with discolouration problems, especially when corroded by aggressive water, are conducive to the development of biofilms. When manganese is present in the network, these biofilms collect intensely coloured manganese particles and incorporate them within layers as they build up. (This has been evidenced by the Prediction and Control of Discolouration in Distribution Systems (PODDS) research at Sheffield University – see www.podds.co.uk.) These layers can be easily released during higher flow events (such as mains bursts) causing peaks of discoloured water reaching customer taps. Corrosion of the surface of the pipes also contributes to the release of these layers.

Ideally these mains would be self cleansing in terms of the build up of deposits on the inside surface. However this depends on the water passing through at a sufficient velocity. When mains are oversized and do not reach self-cleansing velocities, deposits can also collect at low points within them again waiting to be disturbed by increased flow. They can also collect within the distribution system more generally, especially at dead ends, even where preferred pipe materials have been used.

3. Why we are different

We have a unique set of circumstances among water supply companies in the UK which has contributed to relatively poor performance for discolouration of water in recent years. These circumstances include source water type (reservoirs rather than rivers and groundwater sources), raw water quality and makeup (manganese), changes in water demand over time (industrial decline) and regional demographics. Some companies (such as South West) have one or more of these characteristics, but we are the only company to have them all in combination. Our analysis shows that these differences explain most or all of the differential in performance between us and other companies. This section discusses each of these characteristics in turn.

3.1. Raw water type and quality

There is evidence that harder waters have a stronger conditioning effect on water mains by way of a build-up of calcium carbonate that acts as an internal protective layer preventing corrosion of the iron pipe (see S Mcneill, Laurie & Edwards, Marc, AWWA, 2001). Water drawn from impounding reservoirs is generally softer than river and groundwater sources. Appendix 1 map A shows the different geologies in our area compared to other companies. As a consequence our raw water is softer and more aggressive compared with other companies.

The biggest challenge we face, however, is the naturally high level of manganese in our raw water. As shown in the previous section we have the highest reported level of manganese at the customer tap and the highest proportion of water served from impounding reservoirs (not including pumped storage).

There is very little information available regarding manganese concentrations in raw water by geographic location in the UK in published analysis and scientific papers. However there is evidence from our own operating area that elevated manganese is found in higher concentrations in upland reservoirs where the bedrock consists of older sedimentary rocks. The highest concentrations of raw water manganese are found in such areas, particularly on the edge of the South Wales coalfield at the head of the valleys, where many of our largest reservoirs are located, as well as certain areas in North Wales. Appendix 1, map B shows manganese concentrations in stream sediments in different parts of the UK, showing that in South East Wales in particular where our population is concentrated there are high levels of manganese.

For other companies who have a similar level of upland reservoirs, the bedrock is generally of a different, younger, composition, suggesting that raw water manganese concentrations are likely to be lower.

4. Overview of acceptability of water strategy for AMP 7

Section 2 explained the causes of discoloured water, and Section 3 explained why we are particularly susceptible to these causes. This means that despite significant improvements in recent years we are still one of the worst performing companies on acceptability of water.

The high historic levels of manganese in the water leaving our treatment works has left a legacy of deposits within the distribution system that needs to be addressed. However, it would not represent good value for money for customers if we were to implement our DWI-mandated Network Quality (Zonal Studies) programme without also addressing the causes of discolouration at source. Failure to do this would mean that in a few years further expenditure in the network would be required to address a further build up of manganese in the system.

We have therefore proposed a significant programme of service enhancement for AMP7 on acceptability, the majority of which is focused on tackling the problem ‘at source’ by addressing manganese in catchments and at treatment works. This expenditure is described in Section 5 below.

In addition to the ‘source’ element, we will invest in our networks principally through the Network Quality (Zonal studies) programme, which is covered in a separate investment case as is driven by the need to comply with DWI legal notices. In addition, we are continuing to introduce productivity innovations and new operational practices requiring new investment in order to drive further improvements. These are summarised in Section 6.

The table below shows the improvements expected in each year from each element of our programme for AMP7. Taken together our planned investment for AMP7 will achieve our overall targeted improvement to the performance we offer our customers, from 2.40 down to 2.00 contacts per 1,000 population.

Year	Manganese reduction	Network quality (DWI)	Productivity	Total Improvement	Customer Acceptability Performance / 1000 Population
AMP 6 end					2.40
Benefit Yr 1	0.03	0.034	0.008	0.072	2.33
Benefit Yr 2	0.04	0.081	0.008	0.129	2.20
Benefit Yr 3	0.02	0.06	0.002	0.082	2.12
Benefit Yr 4	0.01	0.059	0.002	0.071	2.05
Benefit Yr 5	0.004	0.04	0.002	0.046	2.00

We are also proposing expenditure of of £3m targeted specifically at reducing the number of ‘worst served’ customers who suffer from repeated problems of discolouration. This is covered in Section 7.

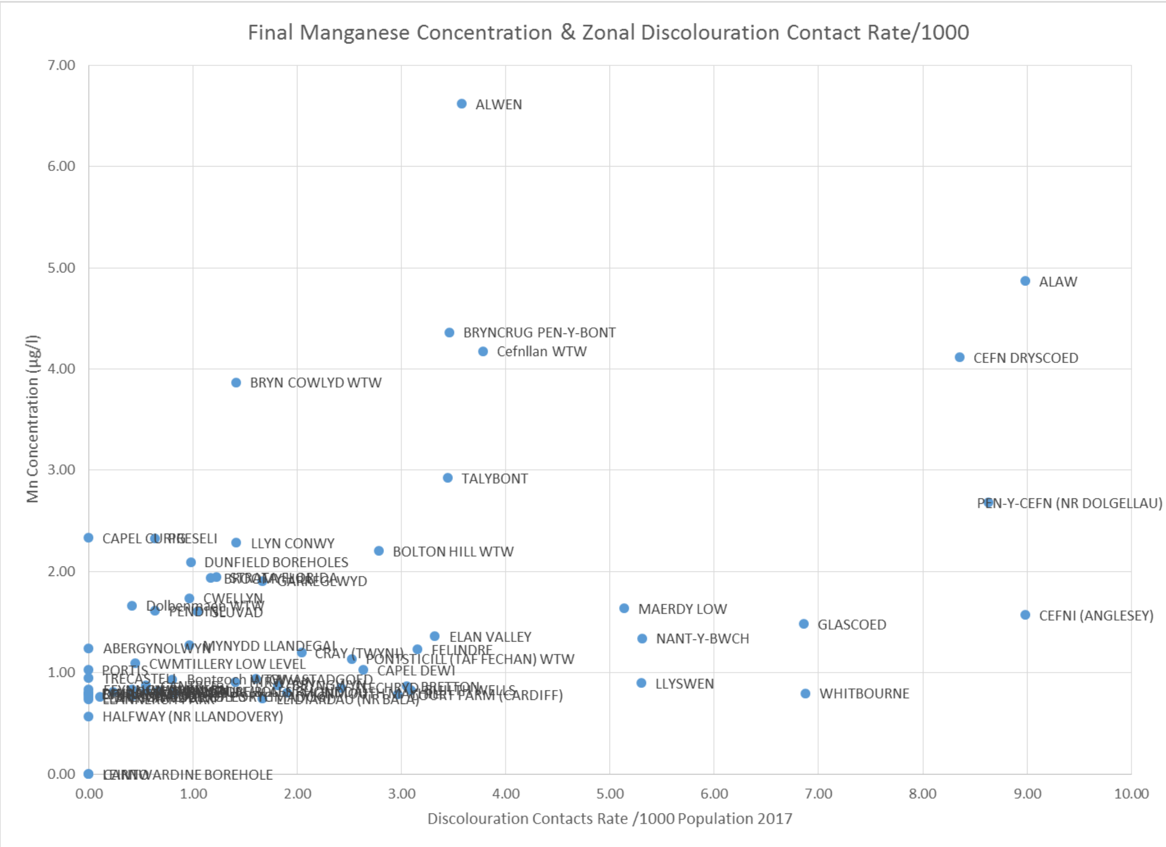
5. AMP7 Manganese reduction programme

5.1. Background

We recognise that residual manganese in final water output from the treatment works contributes towards the root cause of discolouration for customers. We have therefore developed a prioritised programme of investments at targeted treatment works, costing £16.8 million. This will reduce manganese entering the network through a programme of catchment, impounding reservoir and treatment works solutions.

5.2. Prioritisation of supply areas needing investments for manganese reduction

In selecting our manganese reduction programme we reviewed performance data and identified those that perform poorly for manganese and that supply zones that generate a high number of contacts for discolouration. The graph below illustrates the modelled contribution that each supply area has towards customer contacts based on average final manganese.



As part of a phased approach, we have set a target of reducing the average concentration of final manganese to at least 2 µg/l at all sites. Once we have finished the current programme of targeting 2 µg/l we will review the benefits that have occurred and consider whether further treatment improvements are warranted.

To identify the highest priority treatment works, where investment and reducing manganese concentration would contribute towards a reduction in customer contacts, we used a multi criteria selection approach including highest contacts in a zone and highest average manganese in output.

Using this criteria we selected sites that firstly had an average final manganese concentration of greater than 2 µg/l and also sites that were not planned to receive significant investment during AMP6. From a longer list of 14 treatment works we prioritised 6 sites for further investigation and solution development, as show in Table 1.

Table 1 – Priority site selection for investigation & solution development

WTW	Extra Contacts Attributed to Mn
Alaw	61
Cefn Dryscoed	55
Alwen	45
Pen y Cefn	6
Cefn Llan	5
Pendine	1
Total	**173**

We produced a second list of treatment works with an average final manganese concentration of between 1 and 2 µg/l and were also not planned to receive significant investment in AMP6. This second list of sites in Table 2 has been progressed for more minor improvements in manganese removal on the basis that process optimisation would deliver the best value benefits.

Table 2 - Additional 9 sites where process optimisation would improve discolouration performance

WTW	Extra Contacts Attributed to Mn
Felindre	65
Pontsticill	27
Sluvad	20
Nantybwch	15
Cefni	8
Whitbourne	7
Llwynon	5
Capel Dewi	3
Cwellyn	2
Total	**152**

Through a combination of more stringent engineering solutions at the 6 higher priority sites as well as process optimisation at the list of secondary 9 sites we have projected a net benefit of reducing our overall metric by 0.104 calls per 1000 customers.

5.3. Scope of works and optioneering

In support of the PR19 investment plan development we set up a Solutions Development team made up of consultants from our Asset Management Framework and our Capital Delivery Alliance.

The Solutions Development Team carried out a detailed investigation into each of the high priority sites (excluding Cefn Llan had previously been investigated and costed as part of another scheme) to identify the root cause of elevated manganese.

This involved the following:

- Review of current treatment processes and analysis of raw water data using both telemetry systems and laboratory analysis
- Review of existing risks associated with the treatment works related to manganese using both our in house risk management database; Investment Manager and Drinking Water Safety Plans
- Production of options to reduce manganese output from the treatment works including impounding reservoir, treatment process and optimisation options
- Overview of constructability and commissioning constraints and health and safety issues with each of the possible solutions that would influence their inclusion in the business plan.
- Costing of each proposed solution using for the majority of options our in house Unit Cost Database and Solution Target Pricing Tool.

Following the site investigations the Solutions Development Team produced and costed a number of solutions, each with a predicted cost benefit, targeting a reduction in average final manganese to less than 2 µg/l. Costs for each option were produced using our Unit Cost Database, which has been benchmarked by Mott MacDonald as part of the PR19 process, confirming that our costs (particularly for non-infra assets) are efficient and consistently lower than industry averages.

WTW & Proposed Investment (£m)	Preferred Option	Alternative Options Considered	Reason for selecting preferred option
Alaw £3.42 m	Replace sand in existing RGFs with GAC and convert existing GAC to manganese oxidation filters	1. Convert existing RGFs to combined primary filtration and manganese removal followed by existing GAC 2. Add additional stage of manganese removal filters	Sand grade GAC as a primary filtration process would have a secondary benefit of reducing THM pre-cursors prior to a combined manganese removal stage combined with chlorine dosing to assist oxidation of manganese. Questions were raised over the effectiveness of alternative option 1 and option 2 was very expensive with available space for construction also an issue

WTW & Proposed Investment (£m)	Preferred Option	Alternative Options Considered	Reason for selecting preferred option
		between existing RGFs and GAC	
Cefn Dryscoed £1.71 m	Installation of de-stratification process in impounding reservoir as well as minor process improvements and optimisation	1. Do Nothing 2. New treatment stage with installation of dedicated manganese removal filers	Cefn Dyscoed is one of our worst performing sites in terms of manganese performance with average manganese of 5.8 µg/l and up to 350 complaints for discolouration generated annually. Therefore the do nothing option was not viable. The additional treatment process was costed at £12 million and although likely to be effective, was not cost beneficial should the decision be made to build additional processes as part of a wider scheme to resolve raw water deterioration in a future AMP.
Alwen £0.82 m	Installation of reservoir de-stratification system in the impounding reservoir as well as minor process improvements and optimisation	1. Do nothing 2. Replace existing treatment stage with alternative treatment	The do nothing option was not considered viable due to current poor performance of existing manganese removal stage. Replacement of the existing treatment was a very expensive option although would be constrained by space and would have a significant impact on the sludge processing plant which also may need upgrading.
Pen y Cefn £0.33 m	Retain aluminium sulphate dosing, conversion of existing RGF filters to catalytic manganese removal media, addition of manganese oxidation upstream of filters using pH correction and chlorine dosing	1. As the chosen option but replace existing aluminium sulphate coagulant with ferric sulphate 2. As per the chosen option and alternative option 1 but replace pH control and chlorine dosing with super-chlorinated backwash 3. Addition of second stage manganese	Highest cost benefit and lowest risk option chosen. Although final manganese at Pen y Cefn is greater than 2µg/l, the number of complaints generated is relatively low. The chosen option therefore would be most suitable to start. There is greater risk in using an alternative coagulant or major engineering construction scheme in alternative options 1, 2 and 3 which the investigation has highlighted would not offer any additional benefit.

WTW & Proposed Investment (£m)	Preferred Option	Alternative Options Considered	Reason for selecting preferred option
		removal filtration process upstream of existing filters including catalytic media, pH control and chlorine dosing	
Cefn Llan £4.28 m	Scheme optioneered and designed during Amp 6 for delivery but deferred to AMP7. Includes the addition of manganese removal stage (pressure filters) + additional chlorine dosing for oxidation of manganese	1. Dedicated RGF filtration stage sized for 2 different scenarios based on current abstraction licence and potential future increase. 2. Alternative solutions similar to chosen solution of pressure filters but with differences to capacity and backwash 3. New treatment works with new river abstraction from Afon Rheidol with dedicated manganese removal stage	Chosen option was considered the most suitable due to smaller foot print of new pressure filtration stage over rapid gravity filters. The chosen option will also allow an increased abstraction volume in the future should a new Borehole source be considered. The new treatment works was discounted due to disproportionate cost and cost benefit as well as increased OPEX costs and offer no additional benefit other than a dedicated manganese removal stage.
Pendine £3.26 m	Retain ferric sulphate coagulant dosing, conversion of existing filters to catalytic media (Polarite) plus the additional pH correction and chlorine dosing to aid manganese oxidation	1. Conversion to aluminium based coagulant + pH correction 2. Addition of new dedicated filtration process upstream of existing filters with catalytic media and chlorine dosing 3. Addition of	An aluminium coagulant would not be as effective as ferric for coagulation and would increase THM risk. Alternative options 2 and 3 would be of significant capital cost (£12 & £16 million respectively) with increased OPEX and although forecast to be effective, other cheaper solutions would provide as much benefit.

WTW & Proposed Investment (£m)	Preferred Option	Alternative Options Considered	Reason for selecting preferred option
		new dedicated first stage filtration process, conversion of existing filters to manganese removal with catalytic media + chlorine dosing	
9 other WTWs £3.0m	Process enhancement and optimisation	Investment in new treatment processes	New tighter standard can be achieved through enhancement of existing processes.

Detailed optioneering reports for each of the above investments are available upon request.

6. AMP7 Operational improvements and innovation

Having made improvements significant improvements in our customer contact rate through operational improvements in AMP6, we expect further improvements in AMP7 to be more difficult to obtain. We will continue with the good practices established in AMP6 and build on them in the following ways to gain a further improvement. This will run alongside our investment programmes. The improvements are described below following the 'source to tap' approach. The total expenditure required to implement these improvements is £5m.

i) Catchments

Reservoir Management

Water quality can vary at differing depths within a reservoir during the course of a year. Surface water can be at risk of containing algae in the summer and deep water is at risk of high manganese in the winter. The capability will be restored at all our reservoirs to abstract water at the level with the best quality at a given time.

Effective quality monitoring

We are committed to collecting and analysing sufficient data on the quality and performance of our raw water sources so that we can make informed decisions and predict impacts on our works.

ii) Treatment

Asset Operating Standards

Setting new, challenging and consistent targets for our treatment works will be a significant step towards preventing acceptability contacts and enables us to target investment. Our asset performance aspirations include:

Since our journey to 2ug/l strategy and action plans have been in place, we have seen year on year improvements to our final manganese concentrations. As we continue to improve we will review evidence and tighten the target further in future.

A stable water - 50mg/l hardness minimum at all sites

Historically we have dosed lime and carbon dioxide to stabilise the water and prevent corrosion, however this is a difficult process to get right and can increase levels of turbidity. In order to inform any future change in process, treatment philosophy and identify investment, we are working with Swansea University to look at how differences in water quality will effect corrosion rates.

Residual Dissolved Organic Carbon (DOC) – setting a new standard

We know that Organic Carbon is a potential food source for biofilm growth in water distribution systems, however the link with acceptability performance in the distribution system is still not clear. Organic Carbon can be minimised as part of coagulation processes at treatment works but we do not currently set standards for its removal. We will now set a target of 1 mg/l and monitor performance against this standard.

iii) Distribution

"Locking down" the network

Third party illegal or inappropriate use continues to impact our system. We have continued to lock down vulnerable parts of our network from third party users, with just over 6000 hydrant locks in place. Investment to lock off more of the networks is in place for AMP7. By the end of AMP 7 we will aim to take this figure up to 18,000 hydrant locks.

Calm Networks - Education

We continue to educate our own people and third party users of the network the impact of operating incorrectly and causing discoloured water.

Discolouration Predictor

We have been working with our Data Science team to develop our predictive capability and discolouration risk ranking of areas to support them. This is a long term piece of work which is now being used by operational teams, the model will be refined over time and we will work with the operational teams to get the best use of this data.

Real Time System Quality Monitoring

We will use continuous monitoring of water quality, initially across our trunk mains network and then over time using the "in-zone" pressure monitors as water quality sensors in the distribution system. Four key trunk main systems, Talybont, Crai, Abergele and Taff trunks have continuous monitoring of turbidity via telemetry. Going forward we plan to increase the coverage year on year in line with our Smart Strategy.

Distribution Operation and Maintenance Strategy (DOMS)

Our DOMS document will be refreshed to ensure all our procedures, analysis and reporting is aligned with our strategic objectives. The document is a key part of having a consistent, robust approach to managing quality across the water distribution network of assets.

iv) Innovation

We continue to search for innovation and best practice across our sector and the wider industry and currently have 69 innovation projects targeting improvements in iron and acceptability.

New trials and research include:

- Production of a prototype "Autoflusher" device with the MTC (Manufacturing Technology Centre).
- Collaboration with the Water Research Council (WRC) to develop a matrix of available cleaning techniques
- Installing an in-network Amazon filtration system to remove iron sediment from a poor condition trunk mains.
- Working with Power and Water to investigate if electrocoagulation will produce less manganese as a by-product than conventional iron based coagulants.

Electrocoagulation will also have resilience benefits as it negates the need to rely on a supplier for chemicals.

- Participation in two new research projects with Sheffield University and a number of other Water Companies to assess how storage tanks impact deposition rates of iron and manganese deposits and in addition the effect of phosphate dosing on biofilm formation.
- Our participation in the Sheffield University research into discolouration and biofilms is ongoing and we have placed some key operational colleagues on the steering groups to ensure we are implementing any shared learning.
- The trial of a mixing system to improve consistency of chlorine dosing and reduce fluctuations has continued with a product called Resmix, we are now trying some alternatives that might also assist with minimising disinfectant by-product formation.

The Water Services team continue to share best practice from industry visits and conference attendance through the Innovation Forum.

7. AMP7 Worst served customers programme

7.1. Introduction

As part of our overall strategy to improve the level of service for customers who received a poor service for discolouration, we have planned a programme of targeted mains flushing and renewals together with improvements to manganese performance from treatment works. However, there are a number of customers who receive a repeated poor service for discolouration, who may not benefit from the improvements made as part of the wider investment as the schemes do not score highly as cost beneficial. Therefore, we have developed a separate strategy to target our poorest served customers, which aims to identify properties requiring a dedicated intervention.

7.2. Scoping the programme

To identify a property as worst served, we developed a criteria based on the number of contacts we received related to discolouration and the number of complaints that property had registered at any point over a 2 and 3 year rolling period. The criteria for a worst served customer was set to include customers who had complained at least once in the first year and then registered a repeat call in the same and subsequent years.

The level of investment to target worst served customers targets two key objectives;

- **Worst Served Clusters:** Target areas where there are clusters of worst served customers whose issues will not be addressed by the Zonal Studies outputs programme of work. This will provide the most cost effective way of reducing the number of worst served customers
- **Individual Worst Served:** Identify and resolve the root cause where customers have experienced unacceptable levels of service over a period of three years

We performed an analysis of discolouration contacts between 2013 and 2017 to identify individual or multiple properties currently receiving a poor service for discolouration within water quality zones and postcode areas. Our initial analysis identified 4700 properties that received a repeat poor service for discolouration with those properties calling multiple times in different years. Through the use of cluster analysis we then identified the highest priority 13 individual postcode areas across 8 different water quality zones where customers living in those areas received poor service and will not benefit from interventions as part of the wider zonal studies schemes or from interventions proposed to improve supply interruptions. Across these postcode areas there were 40 individual customers who had complained a total of 159 times collectively for discolouration over a 5 year period. Although analysis has identified 40 worst served customers in these postcode areas who received a repeat poor service, interventions would benefit a total of 324 properties overall.

Customers who have been considered as worst served are usually located in rural locations at the end of the distribution network and therefore more susceptible to discolouration due to lower water velocities, resulting in an increased accumulation of sediment from manganese and corrosion of iron mains. Although carrying out interventions for these customers would not be cost beneficial in many cases, we have a duty of care to all customers to ensure they all receive satisfactory service. Interventions would typically include mains renewal, but may also be made up of a regular flushing programme or inline filters on their service.

7.3. Efficient options and costs

Ofwat commented that we had not set out how we had considered the options for resolving Worst Served Customers on discolouration. However, for worst served customers, we have generally already looked at all the alternatives to pipe cleansing or renewal.

We respond to all customer complaints and use solutions such as flushing and installation of inline filters wherever possible. These solutions resolve the issue in most cases. For worst served customers, those who have suffered repeated problems, we have generally either applied these solutions and they have failed, or we have been unable to apply them for practical reasons. Hence for worst served customers, pipe cleansing or renewal is the only remaining solution.

In terms of cost efficiency, GIS was used to determine the most appropriate intervention and scope for costing using our in-house Unit Cost Database. We are proposing to improve the level of service for the 324 properties identified under worst served analysis whose service would not benefit from wider interventions. We have costed individual schemes for those customers based on length of main to the nearest connecting distribution or trunk connection. Interventions consist of either renewal or cleansing have been costed at £300/metre and £30/metre respectively.

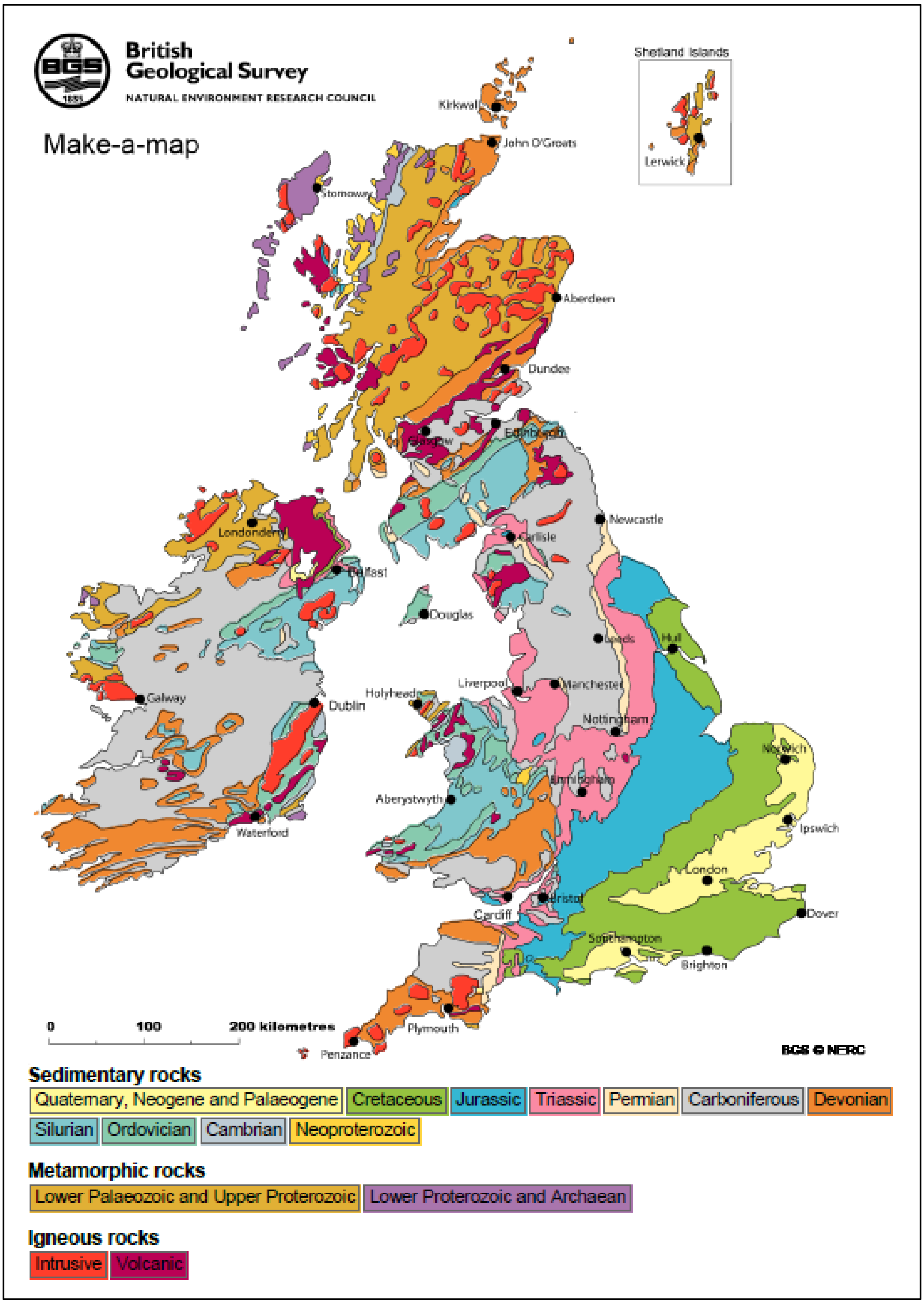
We have analysed the zones where we have the largest clusters of worst served customers as shown below. Our experience of conversations with these customers suggests that the number of complaints underplays the seriousness of the issue, as customers having complained once often do not contact us again immediately when they suffer a repeat. Details of interventions for worst served clusters including costs are as follows:

WQZ	Properties who complained	Number of complaints	Total Properties in Postcode	Length of Main (m)	Intervention Type	Intervention Cost (£)	Cost per Customer (£)
D12	1	8	18	102	Renewal	£30,600	£1,700
D12	2	14	19	293	Cleanse	£8,790	£463
H24	4	9	25	215	Cleanse	£6,450	£258
H24	1	8	6	212	Cleanse	£6,360	£1,060
N19	3	11	50	416	Cleanse	£12,480	£250
N19	5	11	60	3,364	Renewal	£1,009,200	£16,820
L28	5	17	25	1,280	Renewal	£384,000	£15,360
B19	2	12	9	75	Renewal	£22,500	£2,500
L26	3	12	14	1,100	Renewal	£330,000	£23,571
L52	2	10	36	330	Renewal	£99,000	£2,750
L52	3	24	30	3,453	Renewal	£1,035,900	£34,530
L28	4	10	25	268	Renewal	£80,400	£3,216
L23	5	13	7	650	Renewal	£195,000	£27,857
Totals	40	159	324	11758	-	£3,220,680	£9,940

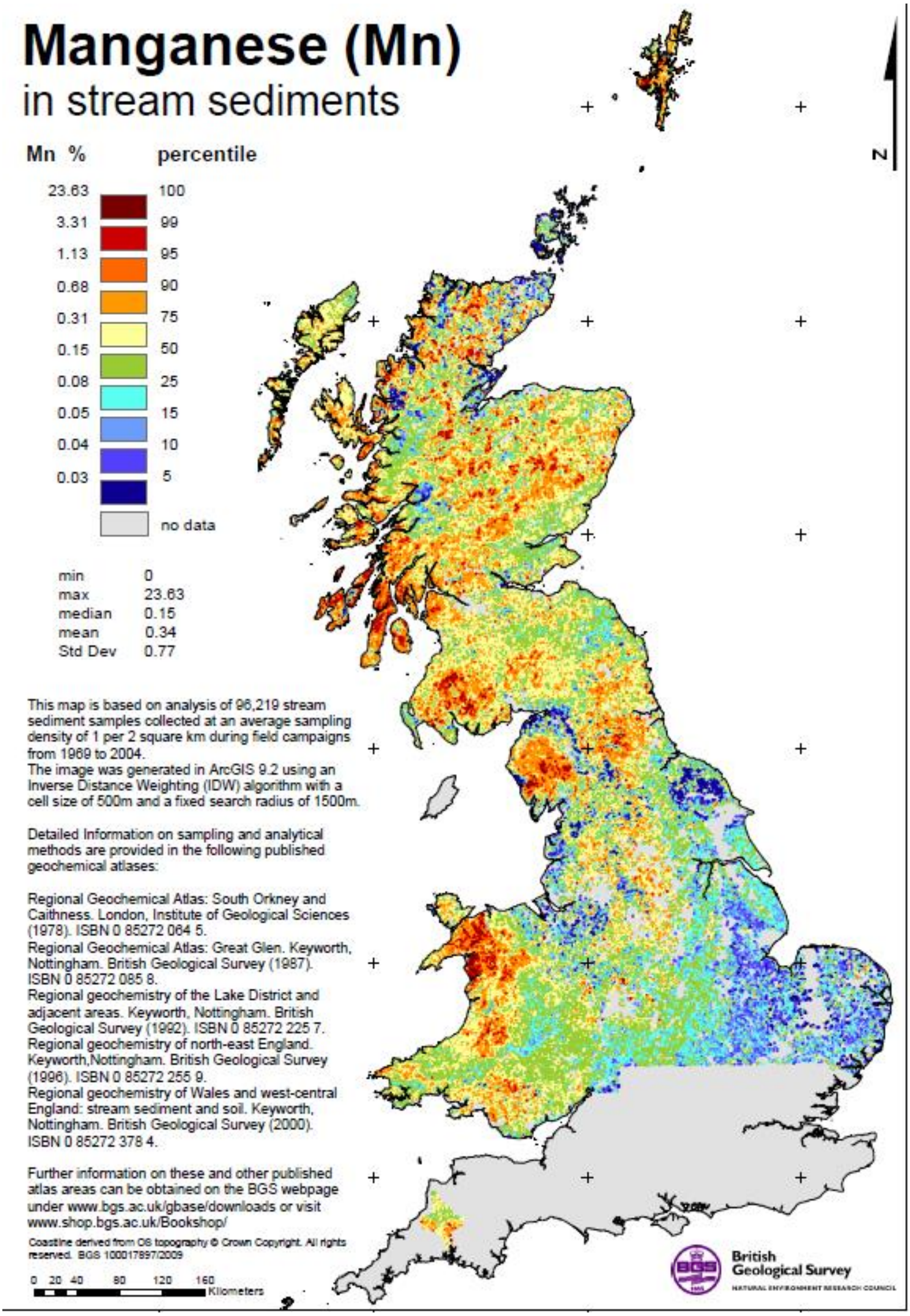
Although schemes have been designed and costed to improve the service of one customer who has been classified as worst served, the schemes themselves will have the additional benefit of improving the service of other customers living close by. A good example of where additional customers will benefit is in the N19 water quality zone where one customer has complained 7 times over a 5 year period for discolouration. An additional 60 properties located in the same postcode are served by the same main so would benefit from the proposed improvement scheme, increasing the associated cost benefit value.

Appendix 1 – Maps

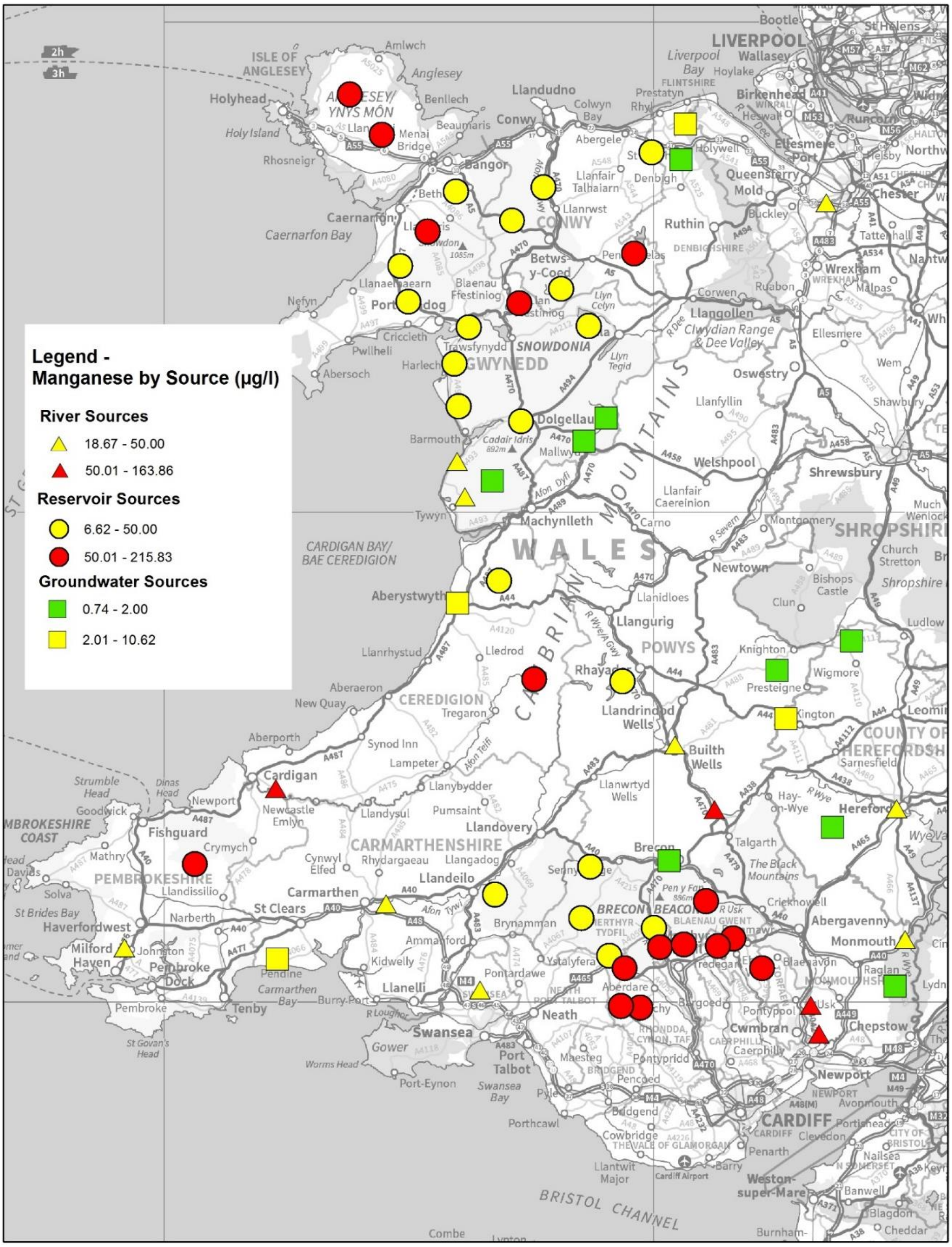
Map A – Geology profile of the British Isles



Map B – Manganese instream sediments


Manganese (Mn)
in stream sediments
Mn %
percentile
23.63
3.31
1.13
0.68
0.31
0.15
0.08
0.05
0.04
0.03
100
99
95
90
75
50
25
15
10
5
no data
min 0
max 23.63
median 0.15
mean 0.34
Std Dev 0.77
This map is based on analysis of 96,219 stream sediment samples collected at an average sampling density of 1 per 2 square km during field campaigns from 1969 to 2004.
The image was generated in ArcGIS 9.2 using an Inverse Distance Weighting (IDW) algorithm with a cell size of 500m and a fixed search radius of 1500m.
Detailed Information on sampling and analytical methods are provided in the following published geochemical atlases:
Regional Geochemical Atlas: South Orkney and Caithness. London, Institute of Geological Sciences (1978). ISBN 0 85272 064 5.
Regional Geochemical Atlas: Great Glen. Keyworth, Nottingham. British Geological Survey (1987). ISBN 0 85272 085 8.
Regional geochemistry of the Lake District and adjacent areas. Keyworth, Nottingham. British Geological Survey (1992). ISBN 0 85272 225 7.
Regional geochemistry of north-east England. Keyworth,Nottingham. British Geological Survey (1996). ISBN 0 85272 255 9.
Regional geochemistry of Wales and west-central England: stream sediment and soil. Keyworth, Nottingham. British Geological Survey (2000). ISBN 0 85272 378 4.
Further information on these and other published atlas areas can be obtained on the BGS webpage under www.bgs.ac.uk/gbase/downloads or visit www.shop.bgs.ac.uk/Bookshop/
Coastline derived from OS topography © Crown Copyright. All rights reserved. BGS 100017897/2009
0 20 40 80 120 160
Kilometers
N
British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Map C – Raw water manganese in Wales categorised by source type and concentration



Map D – 2017 Discolouration Contacts/1000 population by water quality zone