Fluoridation report for Durham County Council.

Dr Brian Plemper.

Senior Network Analyst.

Northumbrian water.

February 2017.

Contents

DRAFT

Background.

Durham County Council has asked Northumbrian Water to produce a report on the feasibility of fluoridating the water supplied to specific regions of Northumbrian waters distribution system to produce a "community water fluoridation (CWF) scheme"

The council has asked for the areas listed below to be examined to determine the requirements of supplying each area with fluoridated water.

1. Bishop Auckland; Wear Valley; Shildon; Spennymoor.

2. The area encompassing Easington and Peterlee.

Northumbrian Water's area of supply.

Northumbrian Water area covers the counties of Northumberland; Durham; Wearside and Teesside in the north of England and the counties of Essex and Suffolk in the south.

The northern area supplies 2.5 million customers with 750 megalitres of water per day (Mld). The company has three active areas within its sphere of operation each one supplying 250 Mld, the Northern Area which runs from Berwick upon Tweed to the River Tyne, the Central area that runs from the Tyne to the North of Teesside and the Southern area that covers the Teesside conurbation down to the northern border of Yorkshire.

Each of the three areas of supply is further subdivided in to System Zones (SZ). These zones are areas that are hydraulically isolated from other parts of the distribution network and can contain between 40,000 to 80,000 properties. The System Zones themselves are then subdivided into District Metered Areas (DMAs) that are themselves hydraulically isolated units that contain between 500 to 2,000 properties.

The boundaries of the S.Z.'s and D.M.A's do not necessarily align with the boundaries of villages and towns and quite frequently; for reasons of hydraulic efficiency, the boundary of a SZ/DMA will divide a local community into sectors with separate supplies sources.

The areas outlined by Durham County Council that are to be investigated for the feasibility of establishing a CWF are all contained within the Central area of operations. This area has four separate WTWs namely Wear Valley, Mosswood, Lumley and Honey Hill as well as 8 Groundwater Stations (GWS). These sources supply water to the Central areas water supply.

Fluoridation within the central area of supply.

Currently only Honey Hill is the only one water treatment works within the central supply zone that has fluoridation as part of the water treatment process. It supplies fluoridated water to customers in County Durham. The output of this works is of the order of [redacted] and supplies [redacted] properties with fluoridated water.

There are, however, other water treatment works and groundwater stations where fluoride occurs as a natural constituent of the source water. The concentration of fluoride from these sources varies and as water are blended this concentration changes.

The diagrams in, Appendix, page i and ii, the fluoride concentrations across the Central area of operations along with its associated System Zones.

Water distribution.

In the UK, water supply was originally carried out by hundreds of small local water boards which, over the decades, have gradually amalgamated and currently there are 25 water companies covering England, Scotland and Wales. Consequently, the configuration of most water distribution systems has developed over time and evolved almost organically as water systems have merged and additional population centre's have expanded the network.

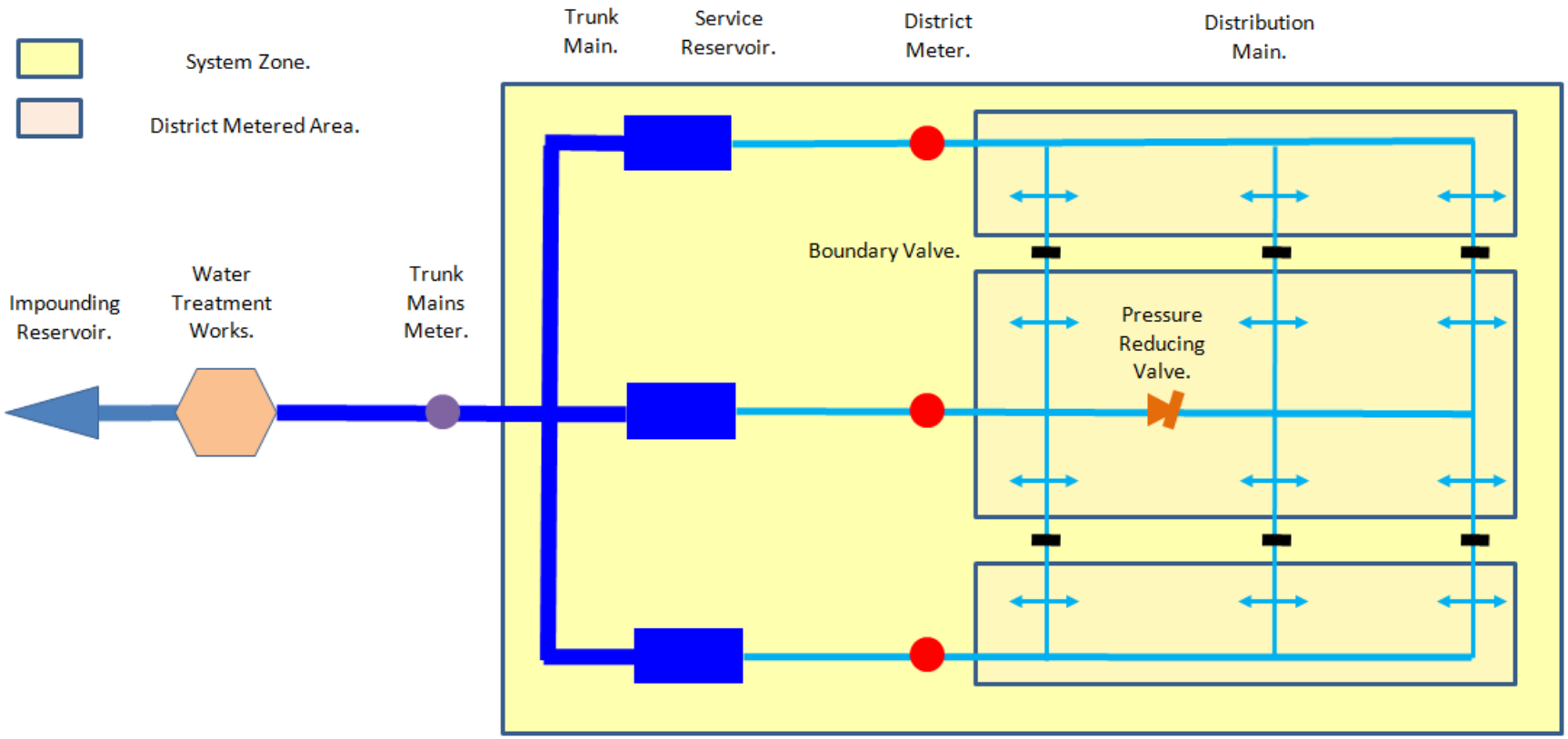
Water distribution systems, to a great extent, tend to be dendritic in nature with some form of water treatment at the head of the system and a downstream network that contains principal trunk mains that branch out into smaller diameter distribution mains that then supply individual households and commercial premises.

As a result this historical development it is not uncommon for a population centre to be supplied from several different sources and in some cases the water mains network within the population centre will be unconnected.

Water companies also compartmentalise sections of the distribution network to allow water accounting to take place and to help in leakage location. The area supplied by a water treatment works is called a system zone which is then subdivided into district metered areas (DMAs) that are hydraulically separate from each other. See diagram below.

DRAFT

Water Network Diagram.



Water treatment.

Generally chemicals additives are used in the water treatment process to remove colloidal particles and to kill certain bacteria and other microbes. At some water treatments works (WTW) fluoride is added at the request of local government or heath authority. Consequently when fluoride is added at the water treatment stage all consumers supplied from that WTW are provided with fluoridated water as is the case at Honey Hill WTW. If fluoride is not added at a WTW, then any area downstream of the works requiring fluoridated water will need an individual fluoridation source.

Hydraulic Analysis of partially fluoridated areas.

There is no fluoridation at any of the WTW that supply the areas identified for CWF, cbut they all do receive water where the fluoride concentrations vary between 0.2 and 0.7 ppm. To ensure that areas stipulated by Durham Council receive water with a fluoride concentration of 1 ppm further fluoridation retreatment will be required.

All of these areas are at the boundary of System Zones and because of the location of each site in relation to the hydraulic connectivity of the network, and the fact that that each site is supplied by disparate water sources, a rationalisation of the physical infrastructure is required that will entail new water mains to be laid and pumping stations to be installed. The extent of this work will depend upon the local infrastructure and supply sources.

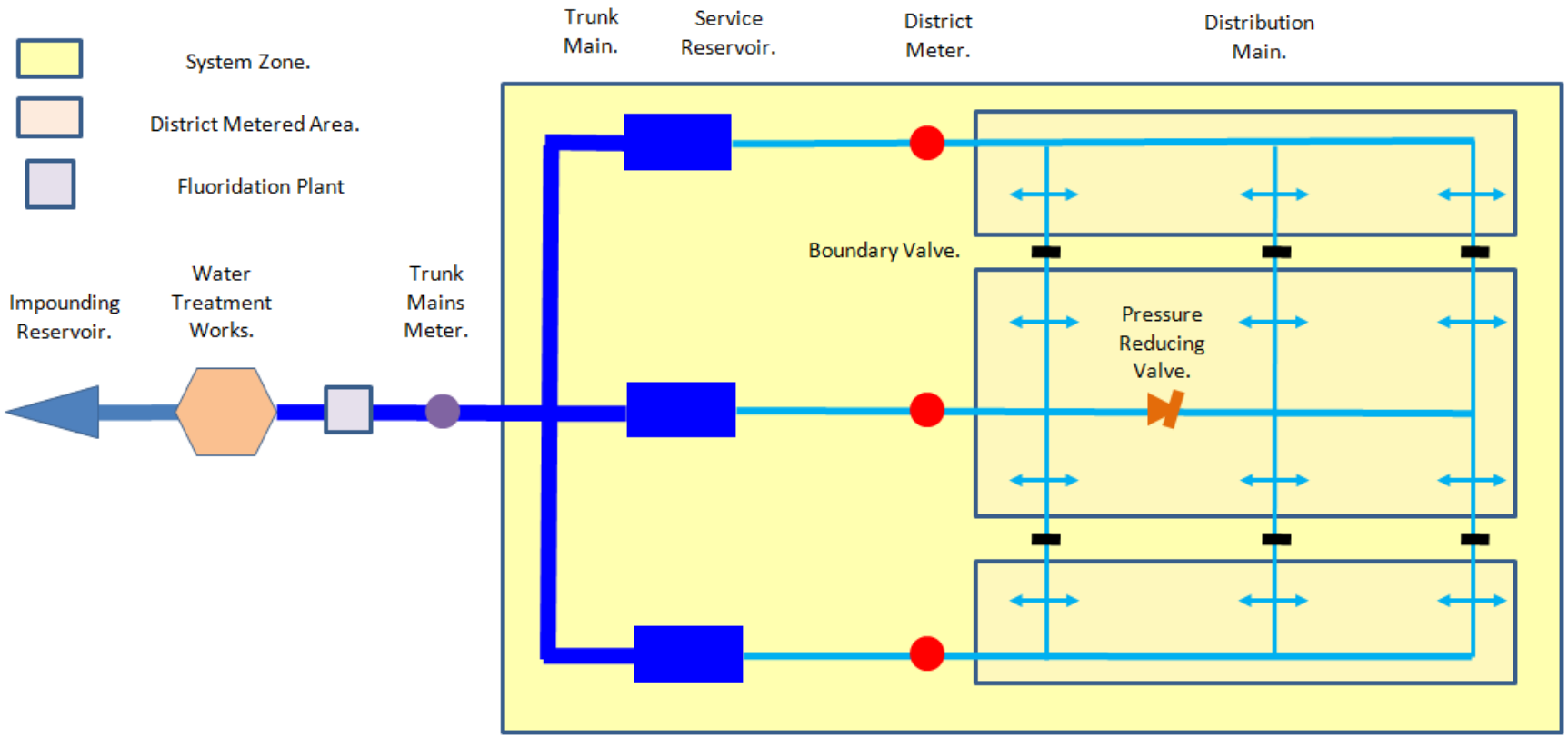
For example the Bishop Auckland area is supplied from three separate sources each one hydraulically isolated from the other, see appendix page iii.

Fluoridation plant.

At present there are 5 WTW within the whole of the NWL area of supply where there are water fluoridation plants. Costing has been carried out on a proposed further 21 and in general the mean cost of implementing an individual CWF would be of the order of £400,000. This figure excludes the cost of the chemical that would be used in the fluoridation process which amounts on average to £35 per megalitre of water treated.

The costs noted in this report are indicative at this stage and apply to the cost of fluoridation in general. Further analyses will be required to provide detailed costs.

Fluoridation at water treatment works diagram.



Option 1. Fluoridation at Water Treatment Works.

The simplest and most economic method of fluoridating a water supply is to construct the plant at the WTW supplying the selected areas. To achieve this for the CWF schemes selected by Durham Council it would require fluoridation plants at Mosswood, Wear Valley and Lumley. If this option was chosen then all of the customers supplied by the WTW, ([redacted]) would receive fluoridated water. This will also capture the selected sites outlined by Durham County Council. Plans of the areas of supply and hence the areas that would receive fluoridated water, if this option is chosen, are shown in the Appendix page I, and covers the whole of County Durham and the whole of the central area, SZ 08 – 13. This option also includes Sunderland and South Tyneside within the fluoridated area.

Installation costs. £1,200,000. £ [redacted] per property.

Fluoridation at selected WTW.

This option allows fluoridation water to be supplied to designated areas identified by Durham County Council as well as their environs and minimises the amount of fluoridated water supplied to Sunderland and South Tyneside. The areas that will receive fluoridated Water are shown in the appendix page vi.

Fluoridation at Mosswood

This would supply all of south Durham, North Wearside and South Tyneside and pick up the Spennymoor; Shildon; and parts of Bishop Aukland, [redacted] properties.

Installation costs. £ 400,000. £ [redacted] per property.

Fluoridation at Wear Valley.

This would supply all of Weardale and East Durham, [redacted] properties, and pick up Easington and Peterlee the rest of Bishop Aukland.

Installation costs. £ 400,000. £ [redacted] per property.

Fluoridation at Lumley.

This would supplement East Durham, [redacted] properties, and also supply Easington and Peterlee.

Installation costs. £ 400,000. £ [redacted] per property.

Full details of cost are shown in the appendix page vi.

Community water fluoridation.

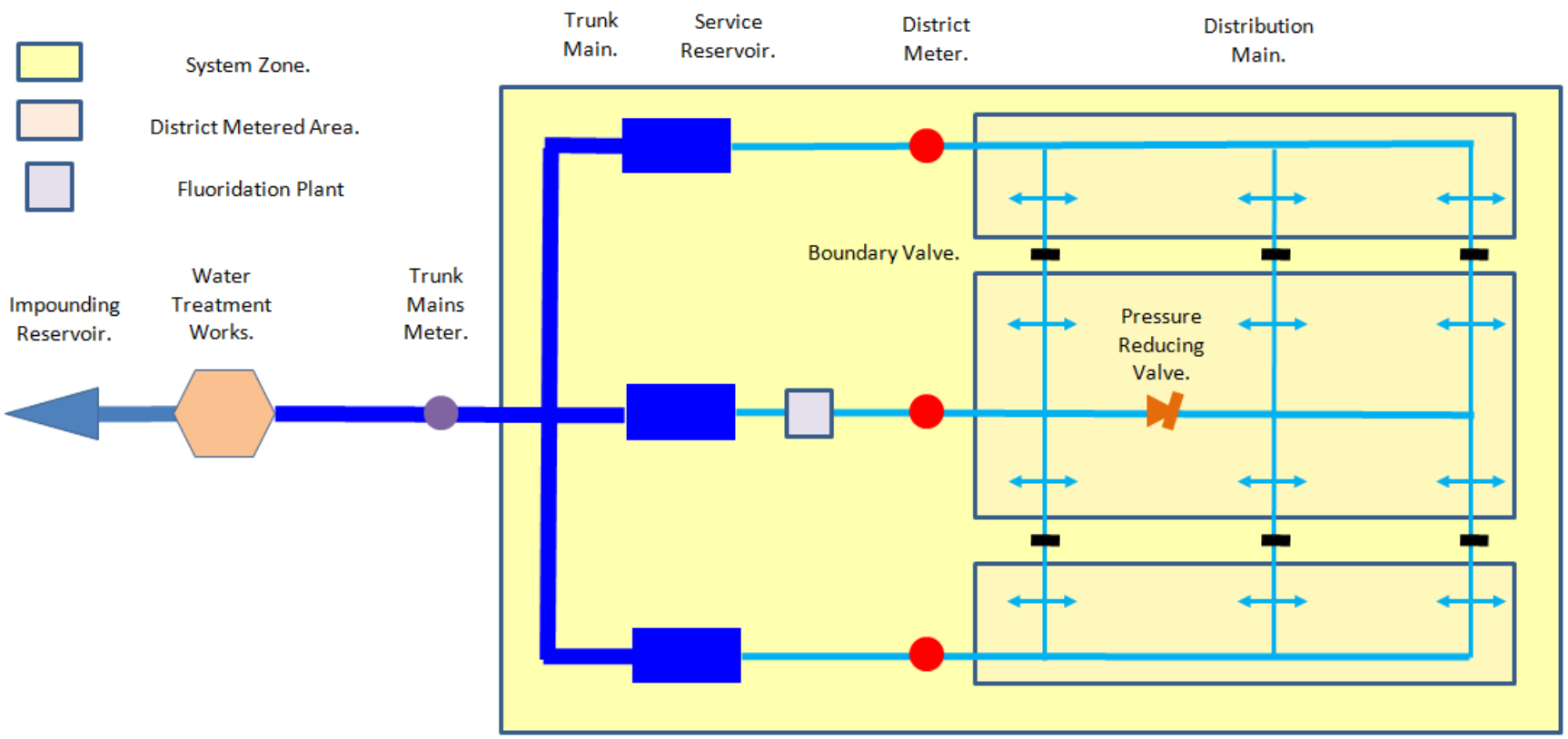
This section deals with the fluoridation of the specific areas identified by Durham County Council. To achieve this aim new water mains and water pumping stations (WPS) will be required to contain the fluoridated water within the specified areas and prevent it from entering areas where fluoride is not requisite

Option 2. Fluoridation at Service Reservoirs.

In this scenario the fluoridation plant is sited at a service reservoir and only supplies the distribution area downstream of the reservoir. See diagram next page.

DRAFT

Fluoridation at Service Reservoir diagram.



Bishop Auckland, Shildon and Spennymoor.

These areas sit on the boundary of three separate System zones, namely: SZ11; SZ13 and SZ14. SZ11 is supplied from Mosswood WTW, SZ13 is supplied from Wear Valley WTW and SZ14 from Broken Scar WTW (located in the Southern supply area). There is no fluoridation at any of these works and an individual plant is required for to provide CWF.

In this case a single reservoir; North Bitchburn, would be chosen as supply source fluoridation would be added to the principle main outlet main, and a pumping station built to overcome hydraulic resistance within the network and enable all three areas to be supplied from the same source .

North Bitchburn can supply Bishop Auckland directly but additional water mains modification will also be required to extend the system to include Shildon and Spennymoor and to isolate the network to prevent fluoridated water entering any part of the neighboring network. (vi)

Installation costs. £ 700,000. £ [redacted] per property.

Wear Valley.

In this case the fluoridation plant and the pumping station will be installed at Wear Valley WTW and a separate water main laid down the length of the valley with the existing supplies to customers the local service reservoirs connected to the new main.

Installation costs. £ 800,000. £ [redacted] per property.

Full details of cost are shown in the appendix page vii

Option 3. Fluoridation at Wearside Groundwater Stations.

The groundwater stations (GWS) in Wearside all have naturally occurring fluoride in the source water.

Average of Value	Year							
Spt Desc	2010	2011	2012	2013	2014	2015	2016	2017
DALTON WTW FINAL WATER	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4
HAWTHORN WTW FINAL WATER	0.9	0.8	0.8	1.0	1.0	1.0		
NEW WINNING WTW FINAL WATER	0.9	0.9	1.0	1.1	1.0	1.0	1.1	1.1
NORTH DALTON WTW FINAL WATER	0.4	0.4	0.4	0.5	0.5	0.4	0.5	0.5
PETERLEE WTW FINAL WATER	0.9	0.8	1.1	1.0	1.0	1.0	1.0	1.0
STONEYGATE WTW FINAL WATER	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.3
THORPE WTW FINAL WATER		0.6	0.7	0.8	0.8	0.7	0.7	0.8

Table showing fluoride concentration measured in mg l^{-1} (ppm).

Fluoridation at Peterlee and Easington.

At present Peterlee receives groundwater containing fluoridated water at 0.4 mg l^{-1} (0.4 ppm) and Easington receives fluoridated water at 0.8 mg l^{-1} (0.8 ppm) and Easington

By modifying the water distribution system Peterlee and Easington can be with groundwater containing 1 mg l^{-1} (1 ppm) of fluoridated water.

1. Peterlee.

By revalving the network it is possible to supply Peterlee directly from New Winning and Pterlee GWS. This option will give Peterlee, Hordon and Blackhall 1 mg l^{-1} (1 ppm) of fluoridated water. At present they receive 0.4 mg l^{-1} (0.4 ppm) of fluoridated water.

Installation costs. £ 5,000. £ [redacted] per property.

2. Easington.

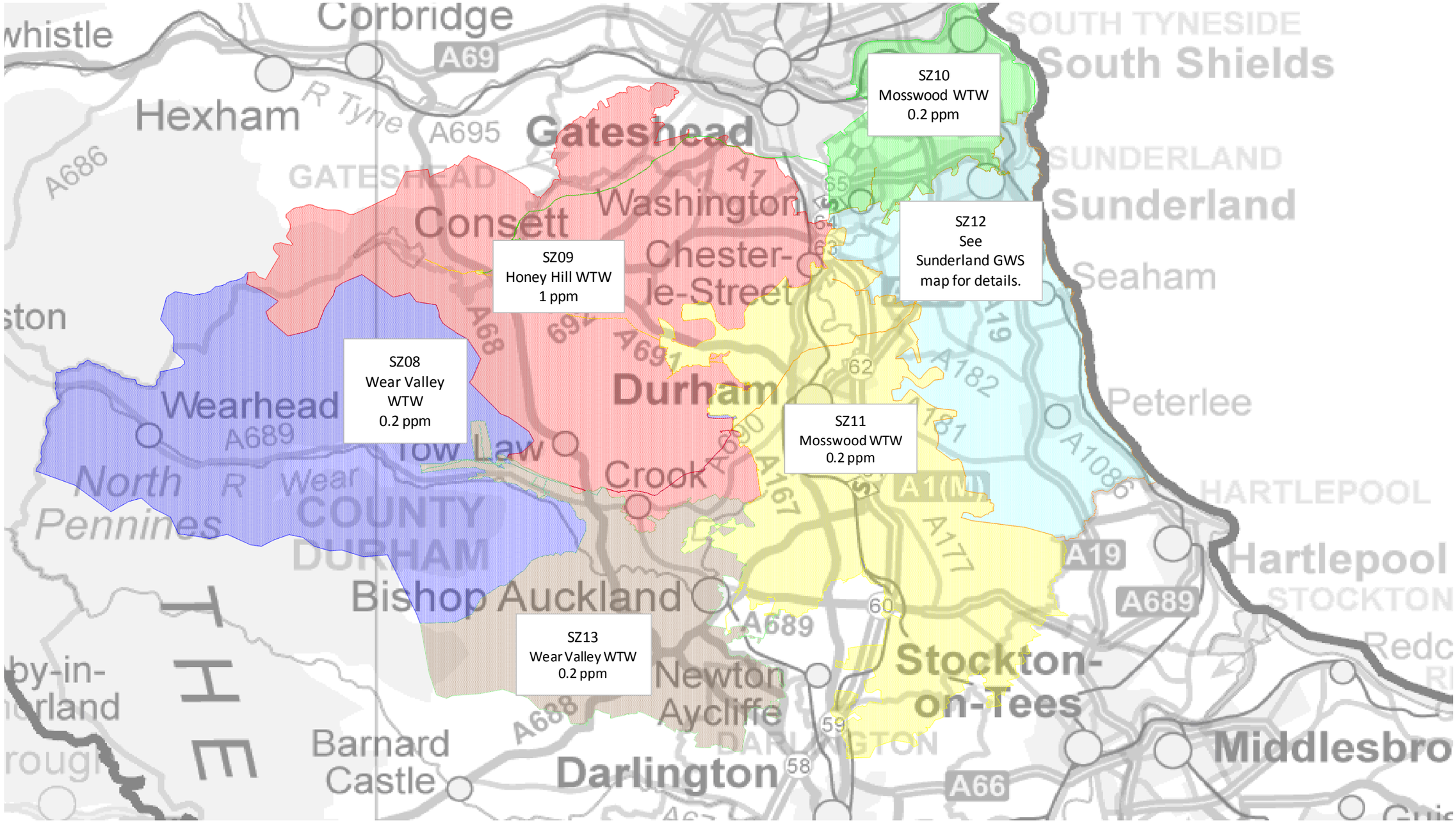
At present Easington receives water fluoridated at 0.8 mg l^{-1} (0.8 ppm) to enavbe them to receive fluoridated at 1 mg l^{-1} (1 ppm) a new main will required between Pterlee and Easington.

Installation costs. £ 300,000. £ [redacted] per property.

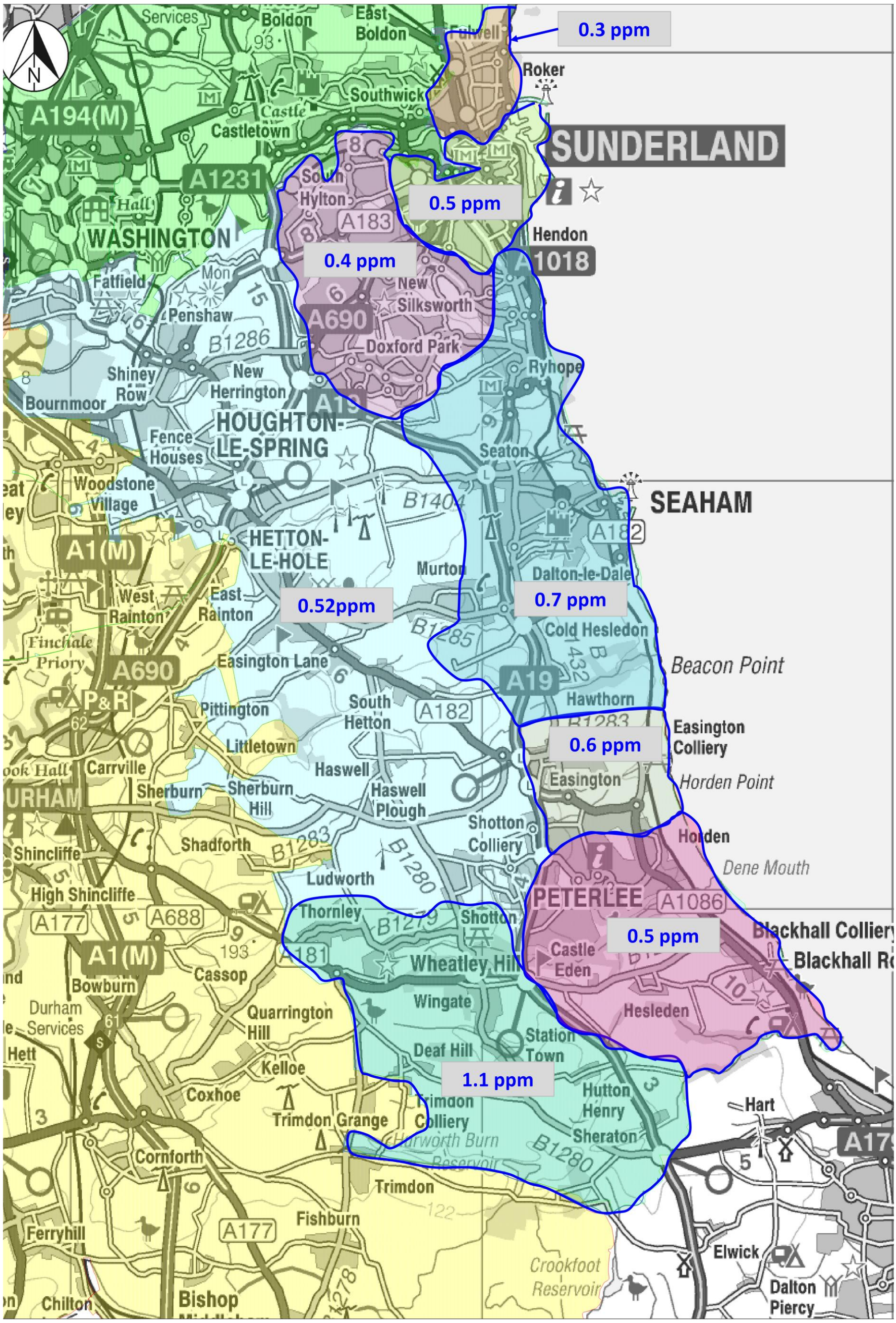
Appendix.

DRAFT

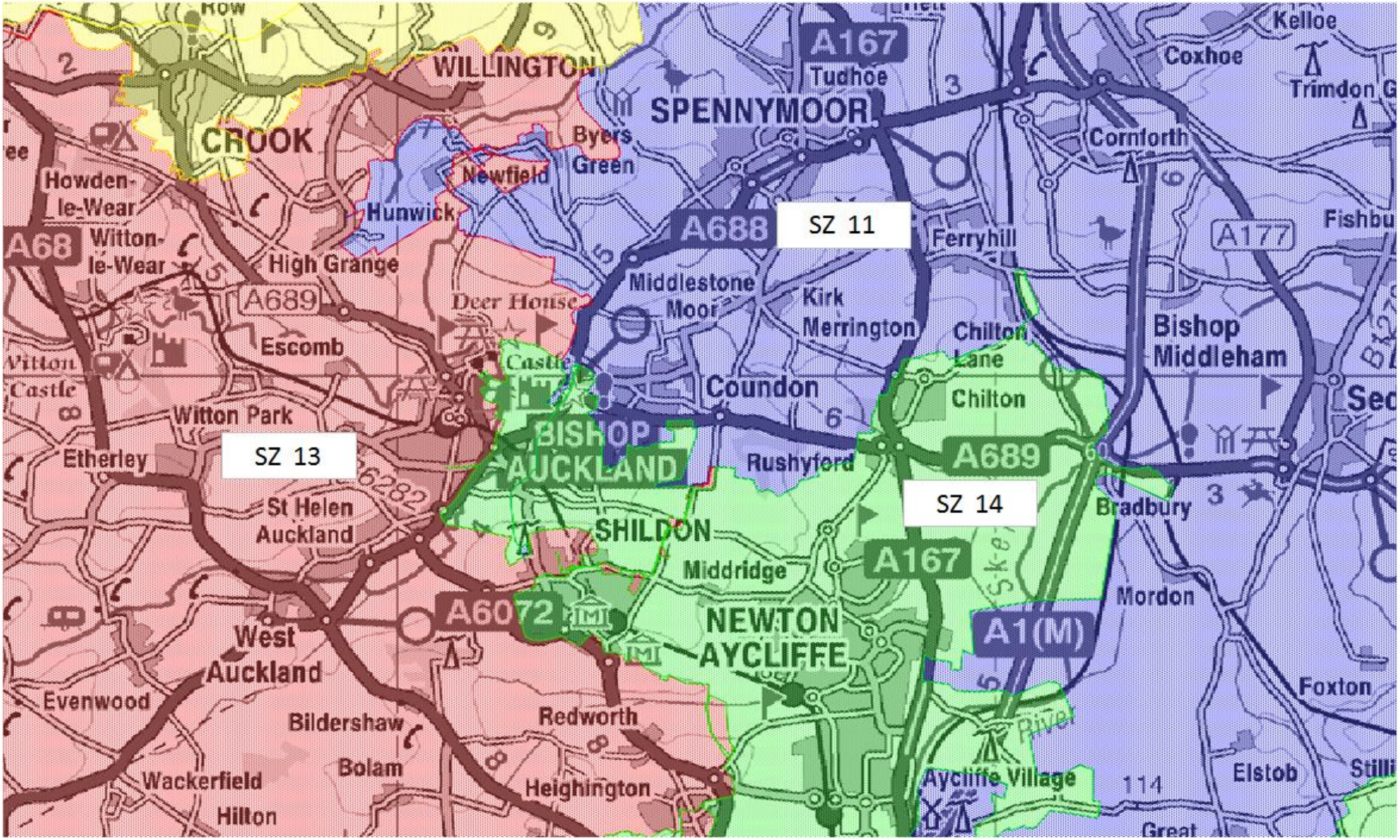
NWL Central area of supply. Showing existing levels of fluoride concentrations.



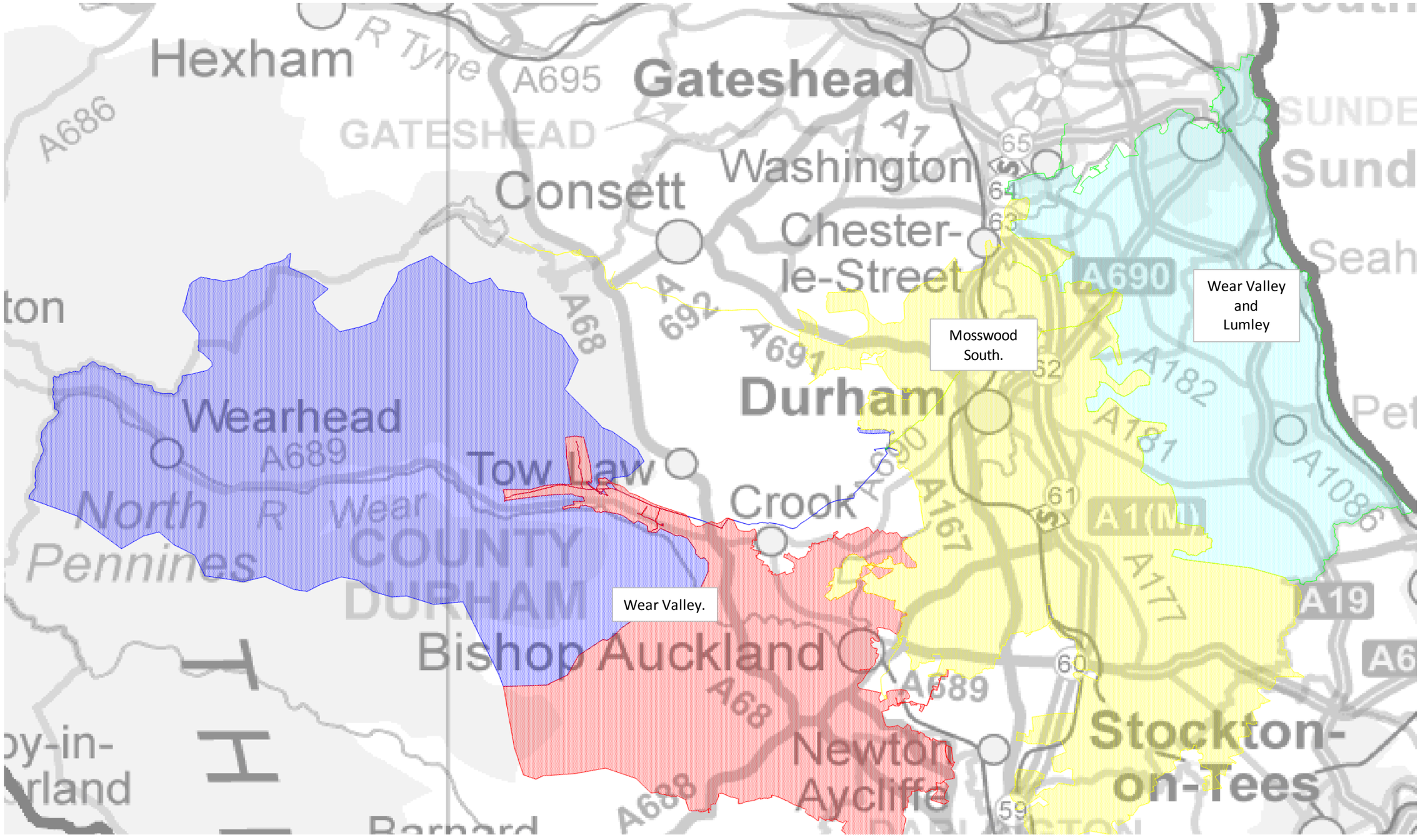
System Zone 12 Showing existing levels of fluoride concentrations.



Bishop Aukland and Shildon System Zone Plan.

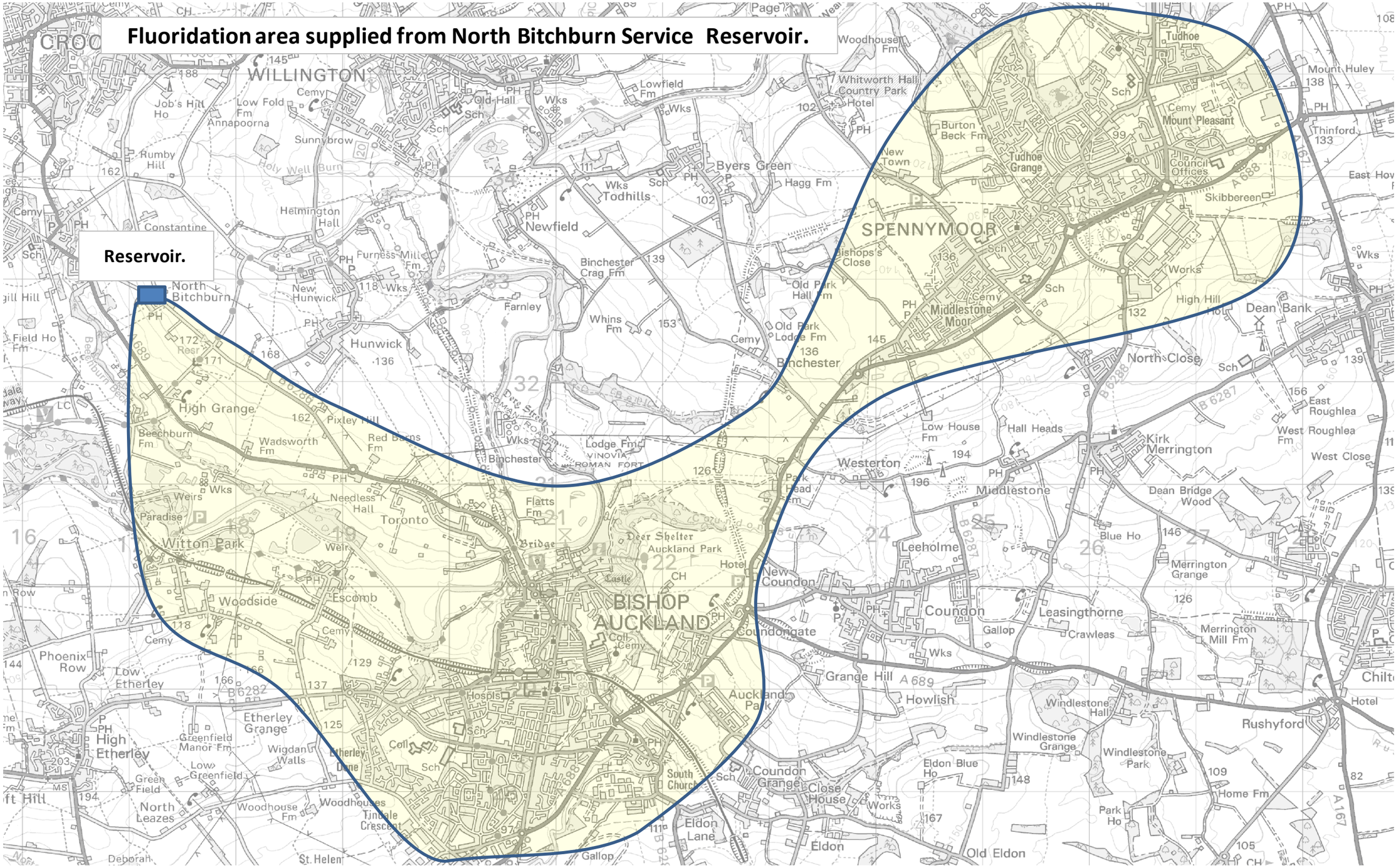


Area of supply of Wear valley, Mosswood South and Lumley



Location of Bitchburn Fluoridation Plant.

Bitchburn fluoridation scheme for Bishop Aukland, Shildon and Spennymoor..



Detailed fluoridation costs for WTW.

Fluoridation Plant Cost (£)			400,000	
3 x Fluoridation Plant Cost (£)			1,200,000	
Treatment Cost Rate (£ per MLD)			35	
Site.	Properties.	Flow rate. (Mld)	Instalation cost per property (£)	Treatment cost per Prop per Year (£)
3 WTW	[redacted]	[redacted]	[redacted]	[redacted]

Fluoridation Plant Cost (£)			400,000	
Treatment Cost Rate (£ per MLD)			35	
Site.	Properties.	Flow rate. (Mld)	Instalation cost per property (£)	Treatment cost per Prop per Year (£)
Mosswod	[redacted]	[redacted]	[redacted]	[redacted]

Fluoridation Plant Cost (£)			400,000	
Treatment Cost Rate (£ per MLD)			35	
Site.	Properties.	Flow rate. (Mld)	Instalation cost per property (£)	Treatment cost per Prop per Year (£)
Wear Valley	[redacted]	[redacted]	[redacted]	[redacted]

Fluoridation Plant Cost (£)			400,000	
Treatment Cost Rate (£ per MLD)			35	
Site.	Properties.	Flow rate. (Mld)	Instalation cost per property (£)	Treatment cost per Prop per Year (£)
Lumley	[redacted]	[redacted]	[redacted]	[redacted]

DRAFT

Local Fluoridation Schemes.

Fluoridation Plant Cost (£)			400,000	
Water pumping station (£)			100,000	
Water mains rationalization (£)			200,000	
Total			700,000	
Treatment Cost Rate (£ per MLD			35	
Site.	Properties .	Flow rate.	Instalation cost per property	Treatment cost per Prop per Year
		(Mld)	(£)	(£)
Bishop Aukland	[redacted]	[redacted]	[redacted]	[redacted]

Treatment Cost Rate (£ per MLD			35	
Site.	Properties .	Flow rate.	Instalation cost per property	Treatment cost per Prop per Year
		(Mld)	(£)	(£)
Peterlee	[redacted]	[redacted]	[redacted]	[redacted]

Fluoridation Plant Cost (£)				
Water pumping station (£)				
Water mains rationalization (£)			300,000	
Total			300,000	
Treatment Cost Rate (£ per MLD			35	
Site.	Properties .	Flow rate.	Instalation cost per property	Treatment cost per Prop per Year
		(Mld)	(£)	(£)
Easington	[redacted]	[redacted]	[redacted]	[redacted]

DRAFT