ANNEX B1.6

Emerging Substances

This document has been written in line with the requirements of the RAPID gate two guidance and to comply with the regulatory process pursuant to Severn Trent Water's and Affinity Water's statutory duties. The information presented relates to material or data which is still in the course of completion. Should the solution presented in this document be taken forward, Severn Trent Water and Affinity Water will be subject to the statutory duties pursuant to the necessary consenting process, including environmental assessment and consultation as required. This document should be read with those duties in mind.

Grand Union Canal Transfer SRO

Affinity Water, Severn Trent Water, Canal & River Trust

Technical Note

Author and recipient names redacted

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1. Introduction

1.1. Purpose

The purpose of this technical note is to outline the approach and summarise the findings of a review to identify a list of potential emerging substances that should be considered for monitoring in Minworth Wastewater Treatment Works (WwTW) effluent. These emerging substances have been categorised to consider their suitability for monitoring as part of the Grand Union Canal (GUC) Strategic Resource Option (SRO) work. The full analysis involved in this review is included in the spreadsheet accompanying this note.

1.2. Background

1.2.1. The Grand Union Canal SRO

The GUC SRO involves a collaboration between Affinity Water (AfW) and Severn Trent Water (STWL) alongside the Canal & River Trust (The Trust) to deliver a transfer of water from Minworth WwTW in the Midlands to AfW in the South East using the existing canal network.

1.2.2. Emerging substances

In 2021 the Environment Agency (EA) and Drinking Water Inspectorate (DWI) requested a review of which emerging substances should be included in future SRO monitoring programmes. Whilst the current analytical programme for GUC arguably includes a broad and well-considered selection of substances, the ability to detect 'emerging substances' is limited by the lack of a clear definition for the term. A strategy was developed by Atkins that addressed the challenge of not being able to anticipate the dynamics of the chemicals released into the environment or the future evolution of chemical policy and regulation over time horizons spanning decades that are relevant to SROs. The strategy was designed to be flexible and responsive to change, without overreacting and resulting in extensive or inappropriate monitoring. High-level guidance was developed and shared with the regulators, EA and DWI, during a workshop on 21st September 2021.

Sharing this initial, high-level guidance ensured efficient management of the programme, but due to different regional operational differences, each SRO may need to adopt different assessments to define their monitoring programme. It is for this reason a more in-depth assessment has been undertaken focussing on the potential emerging substance that may need to be monitored in the source water from Minworth.

1.3. Project aims

Atkins have been commissioned by STWL to provide a means of identifying a list of emerging substances that may need to be included in future monitoring of the source water from Minworth WwTW. The aims of this project are to:

- Apply the strategy and high-level guidance presented to the regulator in autumn 2021[1], and incorporate feedback from the EA, to identify emerging substances within the context of the GUC SRO and specifically the source water from Minworth WwTW.
- Assess the implications for monitoring Minworth effluent within the existing GUC analytical monitoring programme.

2. Methodology

This review was informed by feedback from the EA on the overall strategy, high-level guidance and adopted the following approach:

[1] Atkins (2021) Thames Water SRO – Emerging Substances: DWI/EA workshop slideshow. (unpublished) (5200973-ATK-WQ-PP-096)

1. Compile a list of emerging substances relevant to Minworth WwTW from a range of sources, covering both regulations and research (Table 2-1).
2. Classify and prioritise these substances for monitoring according to specific environmental or drinking water concerns (drivers).
3. Identify which emerging substances were not already included in the GUC SRO Phase 2 (April 2021 – September 2021) and Phase 3 (October 2021 – June 2022) Water Quality Monitoring programmes (5204564/7/DG/007).

Table 2-1 – Information sources used to identify emerging substances relevant to GUC SRO.

Source	Description	Relation to GUC SRO
Existing permit for Minworth WwTW (T/10/36212/R)	This permit specifies the substances already facing enhanced controls and are advised for ongoing monitoring.	Site-specific
Effluent monitoring data[2]	Collected for water quality monitoring and compliance testing	Site-specific
Trade effluent consents (including tankered waste)	All 311 trade effluent consents for Minworth WwTW, and consents for tankered waste accepted from 13 companies in 2019. The discharge from all consented (non-tankered) trade effluent amounts to <6% of the total dry weather flow (DWF) output from Minworth, with the ten largest individual contributors supplying 2% of the total DWF.	Site-specific
UKWIR Chemical Investigations Programme 3 (CIP3) monitoring data	Latest national research programme (superseding and building upon CIP and CIP2) to address the challenges set by the EA's Water Industry National Environment Programme (WINEP). Specific components consulted: • Five year trend monitoring (Chem Mon) • Minworth catchment investigation (Chem 6) • Minworth emerging substances (Chem 14) • Groundwater (Chem 1) • Innovative Pathway Control (Chem 5) • Sludge (Chem 7)	Combination of site-specific studies and wider water industry research
Catchment land use review	Minworth WwTW receives wastewater from a highly urbanised catchment across the West Midlands, comprising large residential areas, urban centres, commercial zones, a combination of heavy and light industry and interconnecting transport infrastructure. In the absence of further intelligence on the detailed activities, inputs and chemical composition of waste from the largest consented traders, potential sources of non-consented discharge and emerging substances were identified through a literature review, which focused on pollutants typically associated with the urban land uses in the Minworth catchment. The reference list is provided in Appendix A.	General findings applied to the specific characteristics on the Minworth catchment
Drinking Water Directive (DWD) 2021[3]	European Commission (EC) directive concerning the quality of water intended for human consumption	General

[2] Environment Agency Water Quality Archive, https://environment.data.gov.uk/water-quality/view/download/new
[3] EU Revised Drinking Water Directive (2021), https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020L2184&from=EN

Source	Description	Relation to GUC SRO
DWI standards[4] and guidance[5]	Standards set for specific substances present in drinking water supplies and guidance to monitor other substances which do not have specific standards applied.	General
EC chemical watchlist[6]	A watch list for substances of emerging concern linked to the DWD.	General
EU candidate substances (current and proposed)[7]	A list of substances of very high concern which require further monitoring before possible listing the Environmental Quality Standards Directive.	General
Prioritisation and Early Warning System (PEWS)[8]	A proof-of-concept approach developed by EA (April 2021) to identify emerging substances and inform policy decisions, covering surface water, groundwater, soil, biota and sediments. PEWS prioritises substances into four groups by risk and certainty. Substances in the top priority group for surface and groundwater from Tranches 1-7 were included in this review.	General

The compiled list of substances was classified according to the taxonomy outlined in Table 2-2 (overleaf) which prioritises each category of substances for monitoring. These categories in priority order are as follows:

- "Foreseeable Protection Measures" – the highest priority group includes the best understood substances that are already facing enhanced controls.
- "Potential Protection Measures" – the next priority group includes substances that are the subject of national research programmes with a standardised analytical methodology.
- "Watching Brief (regulatory framework)" – a lower priority group that includes substances that are of international interest and are being actively followed by UK regulators but are not part of targeted research programmes or with standardised analytical methodologies.
- "Watching Brief (academic developments)" – the lowest priority group that includes substances of interest that are currently part of academic research.

The "watching brief" approach recognises those emerging substances that are of growing interest to regulatory and academic networks and can be elevated to higher priority lists if continued research shows this to be necessary. Where substances have multiple drivers, the highest priority driver determines the overall designation.

The compiled list of emerging substances was compared with the full list of determinands from the existing GUC SRO monitoring programme[9] at Minworth to identify those substances that were already included in current monitoring and those for which monitoring is advised (i.e., those substances with either a "foreseeable protection measures" or "potential protection measures" classification). The full list also includes substances that are not considered to be emerging but are already included in current GUC monitoring and are labelled as such. Two substances with environmental drivers are manually classified as part of existing monitoring although not explicitly included in the GUC monitoring suites. These are 'visible oil and grease', which are part

[4] The Water Supply (Water Quality) Regulations 2016 with 2018 amendments, https://www.legislation.gov.uk/uksi/2016/614/contents
[5] DWI (2021) Requirements for PFAS monitoring by water companies in England and Wales, https://cdn.dwi.gov.uk/wp-content/uploads/2021/10/04203217/Information-Letter-PFAS-Monitoring.pdf
[6] EC Drinking water legislation, https://ec.europa.eu/environment/water/water-drink/legislation_en.html
[7] EC Main provisions on surface water chemical pollution, https://ec.europa.eu/environment/water/water-dangersub/index.htm
[8] HSAC (2021) Recommendations for a Prioritisation and Early Warning System (PEWS) on Chemicals in the Environment, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/992489/HSAC-recommendations-for-the-prioritisation-and-early-warning-system.pdf
[9] GUC SRO Phase 2 Water Quality Monitoring programme 2021-2022 (5204564/7/DG/007)

of Minworth's existing permits and involves non-quantitative visual inspection, and 'total metals', which is from the trade effluent consents is the sum of individual metals that are already included in GUC monitoring.

Table 2-2 – Classification system for emerging substances determined by environmental and drinking water drivers.

Emerging Substance Classification	Example Activities	Environmental Drivers	Drinking Water Drivers
Foreseeable protection measures:	Substances facing enhanced controls within PR24 WFD / DWI (e.g., revised Drinking Water Directive)	• **Minworth WwTW permits** – antimony, arsenic, cadmium, chloroform, iron, nickel, trichloroethylene • **Minworth WwTW effluent monitoring** – antimony, arsenic, cadmium, chloroform, iron, nickel, trichoroethylene • **CIP3 catchment investigations** – Cypermethrin, Hexabromocyclododecane (HBCDD)	• **Revised Drinking Water Directive 2021** – Bisphenol A, Microcystin-LR, Somatic coliphages, Legionella, Chlorate, Chlorite, Halaacetic acids (HAAs), 20 Per- and Polyfluoroalkyl substances (PFAS) including perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA), Uranium, Chromium (total, dissolved), • **DWI guidance** – 47 PFAS species required to be monitored
Potential protection measures:	Subject of national UK research programmes (e.g., Chemical Investigations Programme) with a standardised analytical methodology	• **Minworth WwTW catchment trade effluent consents** – e.g. aluminium, chromium, copper, cyanide, sulphides • **Minworth WwTW tankered waste** – e.g. arsenic, bromide, nickel, phenol, sulphate • **Minworth catchment review based on land use** - e.g. copper, zinc, PFOS, HBCDD, fluoranthene • **CIP3 5 year trend monitoring** – lead, cadmium, PBDE's, PFOA, benzo(a)pyrene, fluoranthene, • **CIP3 groundwater** – metals, BDE's, Steroid Hormones (E1, E2, EE2), polychlorinated biphenyls (PCBs), glyphosate, Aminomethylphosphonic acid (AMPA, metabolite)	• **EC watchlist / DWI guidance or feedback on similar schemes** – Beta-estradiol, Nonylphenol, pathogenic viruses, personal care products and domestic cleaning products, Chromium VI
Watching Brief (regulatory framework)	International interest and progress actively followed by UK regulators,	• **EU candidate substances** - Neonicotinoids, Pyrethroids, Bisphenol-A, Nicosulfuron, Antibiotics (Azithromycin, Erythromycin, Clarithromycin), Diclofenac, Carbamazepine	• **EC watchlist / DWI guidance or feedback on similar schemes** – microplastics, pharmaceuticals, other endocrine disrupting compounds, Chromium III.

Emerging Substance Classification	Example Activities	Environmental Drivers	Drinking Water Drivers
	though not subject of targeted research. Without a standardised analytical methodology	• **CIP3 emerging substances** – e.g. Fipronil, Climbazole, Ranitidine, Perfluorobutane sulfonic acid (PFBS), Perfluoropentanoic acid (PFPeA), Perfluorohexanesulfonic acid (PFHxS), Imidacloprid	
Watching Brief (academic developments)	Many substances of interest including pharmaceuticals such as statins and may be investigated within alternative control studies	• **CIP3 innovative pathway control (mechanism of control)** – Gemfibrozil, Bendroflumethiazide, Metaformin • **CIP3 sludge** – e.g. PAHs, dioxins and furans, polychloronaphthalenes, Clothianidin, para-hydroxy atorvastatin • **EU candidate substances for 3rd watchlist** - Neonicotinoids, Pyrethroids • **Prioritisation and Early Warning System (PEWS)** – e.g. bisphenol A, diclofenac, fipronil, fluoranthene, propiconazole, Di(2-ethylhexyl)phthalate (DEHP)	-

3. Results

The full compiled list (provided in the spreadsheet accompanying this note) includes emerging substances as specified by the environmental/drinking water drivers considered in this analysis and a range of determinands already included in GUC monitoring that are not currently considered to be 'emerging'[10]. The full list contains 461 substances comprising 226 emerging substances and 235 substances that are not currently considered as 'emerging'. Overall, 361 substances on the full list are included in current GUC monitoring.

The 226 emerging substances includes duplicate entries for some metals, reflecting requirements for separate measurements of total concentrations and dissolved phases. This list also includes a separate entry for 'Total Metals' which is specified in the Trade Effluent Consents for Minworth WwTW; although this is likely already covered by the range of metals that are currently monitored, there are no details to specify which metals are included in this aggregate value. Therefore, we include 'Total Metals' as a separate substance under 'Potential Protection Measures' as determined by the Trade Effluent Consent driver.

Of the 361 substances already monitored as part of the GUC programme, 126 are considered to be emerging substances. Others may be re-designated as emerging substances as understanding evolves and the individual drivers are updated over time. The emerging substances that are already monitored include a range of metals and organic compounds derived from pesticides, industrial processes, detergents, flame retardants and pharmaceuticals. Table 3-1 provides a breakdown of emerging substances by category.

Table 3-1 – Count of emerging substances by category and whether part of current GUC monitoring

Category	Total	Included in current GUC monitoring	Not included in current GUC monitoring
Foreseeable Protection Measures	97	66	31
Potential Protection Measures	55	37	18
Watching Brief (regulatory)	39	8	31
Watching Brief (academic)	35	15	20
Total	226	126	100

Of the 100 emerging substances that are not currently included in monitoring, 49 are categorised as having either 'Foreseeable' or 'Potential Protection Measures' and are therefore recommended for future monitoring (Appendix B). These can be identified in the spreadsheet accompanying this note by selecting the appropriate filters on the category column (i.e. Foreseeable or Potential Protection Measures) and SRO Review column (i.e. those without any current monitoring)

The 31 substances with 'Foreseeable Protection Measures' recommended for future monitoring are all driven by the Revised 2021 DWD and DWI Guidance and include disinfection by-products (DBPs), the Legionella virus and additional PFAS substances. The latest DWI Guidance on PFAS specifies monitoring of 47 individual substances but only 19 are included in current GUC monitoring, meaning that a further 28 should be added to the monitoring programme.

[10] For the purpose of this study an emerging substance is considered to be a substance for which there is increasing concern and for which there may be SRO implementation consequences.

The 18 substances with 'Potential Protection Measures' recommended for future monitoring are dominated by environmental drivers including CIP3 Groundwater and the catchment land use review and encompass substances such as nonylphenols, PCBs and some pharmaceuticals.

A further 51 substances that are not currently monitored have been allocated to watching briefs and include a range of pesticides, flame retardants, pharmaceuticals, endocrine disrupting chemicals (EDCs) and viruses.

4. Recommendations

This review has considered a range of environmental and drinking water drivers and produced a list of emerging substances relevant to the Minworth WwTW as the input to the GUC SRO. The findings of this review will be shared with the EA and inform continuing engagement with them on future work relating to emerging substances. The concept of emerging substances is not unique to SROs, like GUC or Minworth, but an approach that regulators take to managing future risks in the water quality environment. In this case, some of Severn Trent Water's Gate 2 SROs have funded a small study in which emerging substances should be considered as part of (future) SRO monitoring,

Current monitoring already includes 126 substances that are considered emerging but an additional 49 are classified as having foreseeable or potential protection measures and are recommended for future monitoring. Regulator agreement for the addition of these parameters was sought on 27th June 2022 (EA) and 30th June 2022 (DWI). The regulators were given the opportunity to comment on this and a period of time was afforded for any amendments that may have been required. There were no comments from the regulators.

A further 51 substances that are not currently monitored have been allocated to a watching brief. This includes two substances (microplastics and 1-hydroxyethylidene diphosphonic acid) that were originally classified as having foreseeable or potential protection measures but had to be moved to a watching brief as these lack a reliable analytical methodology.

It is recommended that the monitoring programme remains flexible and adaptable to account for substances that may increase or decrease in significance over time. The watching brief categories allow substances to be reviewed at agreed intervals (to be decided) to respond to new information to maintain alignment with the wider regulatory view. A full list of the emerging substances recommended for future monitoring can be viewed by selecting the appropriate filters in the spreadsheet accompanying this note.

Appendices

Appendix A. Literature Review References

Comber *et al.* (2014) Source apportionment of trace contaminants in urban sewer catchments. *Environmental Technology*, 36, Issue 5, 573-587.

Rule *et al.* (2006) Diffuse sources of heavy metals entering an urban wastewater catchment. *Chemosphere*, 63, 64-72.

Rule *et al.* (2006) Sources of priority substances entering an urban wastewater catchment – trace organic chemicals. *Chemosphere*, 63, 581-591.

UKWIR (2022) Urban Runoff (including road runoff) and atmospheric deposition – how to apportion pollution load, especially chemicals of emerging concern. UKWIR ref WW/02/B/18.

Appendix B. Substances recommended for future monitoring

Substances	CAS
3:3 FTCA	356-02-5
4:2 FTSA	757124-72-4
4-nonylphenol diethoxylate	9016-45-9
4-nonylphenol monoethoxylate	104-35-8
4-nonylphenol triexthoxylate	51437-95-7
5:3 FTCA	914637-49-3
6:2 Cl-PFESA; 9Cl- PF3ONS	756426-58-1
6:2 FTSA; 6:2 FTS	27619-97-2
7:3 FTCA	812-70-4
8:2 Cl-PFESA; 11Cl- PF3OUdS	763051-92-9
8:2 FTSA; 8:2 FTS	39108-34-4
Aminomethylphosphonic acid (AMPA, metabolite)	1066-51-9
Diclofenac	15307-86-5
Disinfection Byproducts (DBPs)	n/a
DONA; ADONA	919005-14-4
EtFOSA; N-EtFOSA	4151-50-2
EtFOSE	1691-99-2
FBSA	30334-69-1
FHxSA	41997-13-1
FOSA	754-91-6
Haloacetic Acids (HAAs)	This is the sum of the following five representative substances as specified in the revised Drinking Water Directive (2021): chloro- (79-11-8), dichloro- (79-43-6), trichloro- (76-03-9), bromo- (79-08-3) and dibromo- (631-64-1) acetic acid. These are all individually included within current monitoring.
HFPO-DA (Gen X)	13252-13-6
HFPO-TA	13252-14-7
Legionella	n/a
MeFOSA; N-MeFOSA	31506-32-8
MeFOSE	24448-09-7
NEtFOSAA; EtFOSAA	2991-50-6
NFDHA	151772-58-6
NMeFOSAA; MeFOSAA	2355-31-9
PCBs congener 101	37680-73-2
PCBs congener 118	31508-00-6

Substances	CAS
PCBs congener 136	38411-22-2
PCBs congener 153	35065-27-1
PCBs congener 180	35065-29-3
PCBs congener 28	7012-37-5
PCBs congener 52	35693-99-3
PFecHS *CAS No needs checking	133201-07-7
PFEESA	113507-82-7
PFHxDA	67905-19-5
PFMOBA	863090-89-5
PFMOPrA	377-73-1
PFODA	16517-11-6
PFTeA	376-06-7
Propiconazole	60207-90-1
Soluble methane	74-82-8
Tolytriazole	29385-43-1
Total metals	n/a
Tri-(2-chloroethyl) phosphate	115-96-8
Triclocarban (1-(4-chlorophenyl)-3-(3,4-dichlorophenyl)-urea)	101-20-2