Annex C: Strategic Water Quality Risk Assessment for London Water Recycling Schemes

Standard Gate two submission for London Water Recycling SRO

Notice – Position Statement

This document has been produced as the part of the process set out by RAPID for the development of the Strategic Resource Options (SROs). This is a regulatory gated process allowing there to be control and appropriate scrutiny on the activities that are undertaken by the water companies to investigate and develop efficient solutions on behalf of customers to meet future drought resilience challenges.

This report forms part of suite of documents that make up the 'Gate 2 submission.' That submission details all the work undertaken by Thames Water in the ongoing development of the proposed SRO. The intention at this stage is to provide RAPID with an update on the concept design, feasibility, cost estimates and programme for the schemes, allowing decisions to be made on their progress.

Should a scheme be selected and confirmed in the Thames Water final Water Resources Management Plan (WRMP), in most cases it would need to enter a separate process to gain permission to build and run the final solution. That could be through either the Town and Country Planning Act 1990 or the Planning Act 2008 development consent order process. Both options require the designs to be fully appraised and, in most cases, an environmental statement to be produced. Where required that statement sets out the likely environmental impacts and what mitigation is required.

Community and stakeholder engagement is crucial to the development of the SROs. Some high-level activity has been undertaken to date. Much more detailed community engagement and formal consultation is required on all the schemes at the appropriate point. Before applying for permission Thames Water will need to demonstrate that they have presented information about the proposals to the community, gathered feedback and considered the views of stakeholders. We will have regard to that feedback and, where possible, make changes to the designs as a result.

The SROs are at a very early stage of development, despite some options having been considered for several years. The details set out in the Gate 2 documents are still at a formative stage.

Disclaimer

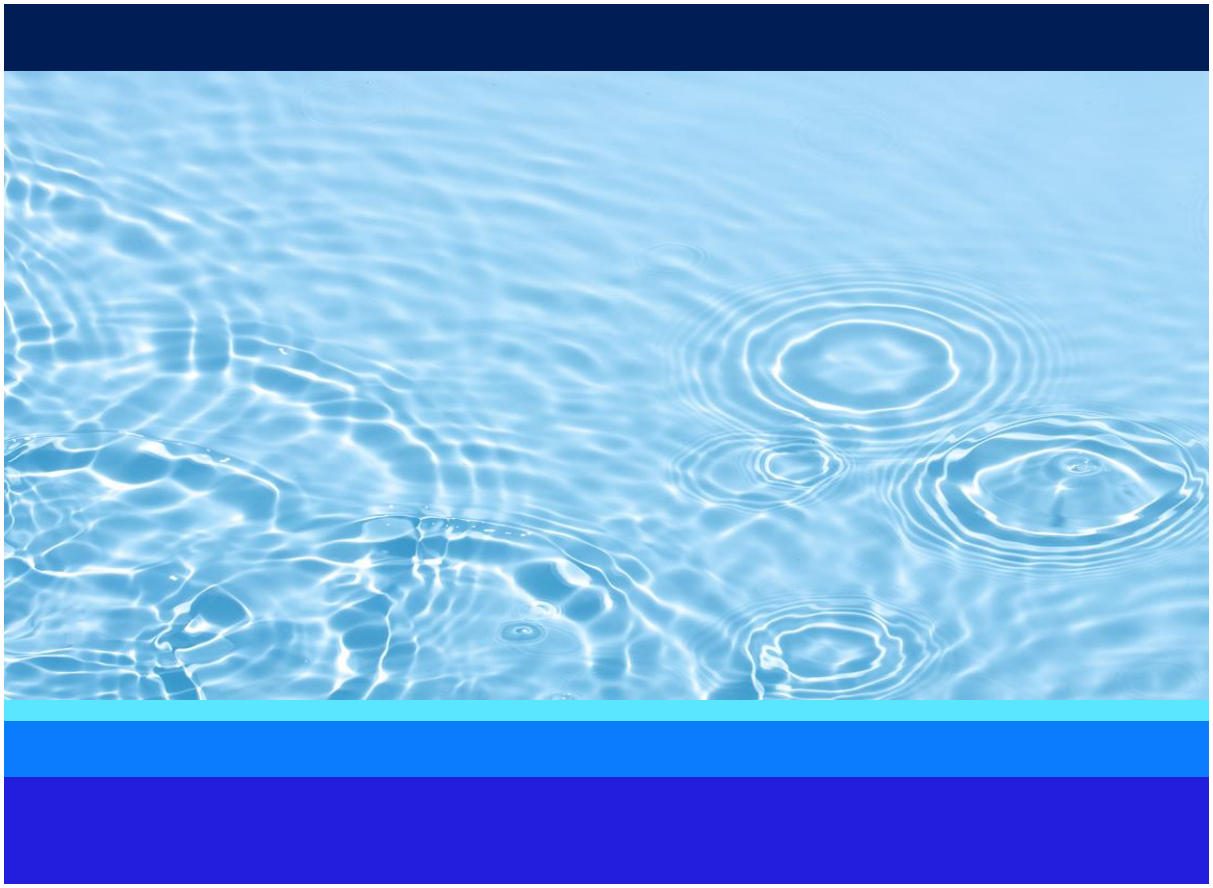
This document has been written in line with the requirements of the RAPID Gate 2 Guidance and to comply with the regulatory process pursuant to Thames Water's statutory duties. The information presented relates to material or data which is still in the course of completion. Should the solutions presented in this document be taken forward, Thames 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.

Annex C: Drinking Water Safety Plan - Strategic Water Quality Risk Assessment (SWQRA) for London Water Recycling Schemes

Document no: J698-GN-DOC-002052-0C

Thames Water Utilities Ltd.
J698

London Water Recycling SRO
13 October 2022



Annex C: Drinking Water Safety Plan -Strategic Water Quality Risk Assessment (SWQRA) for London Effluent Reuse

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Executive summary

This document provides a summary of the Strategic Water Quality Risk Assessment (SWQRA) undertaken for the London Effluent Reuse (LRU) Strategic Resource Option (SRO).

The SWQRA provides a high-level risk assessment based on a drinking water safety approach to identify limiting hazards and assessing their risks across the water supply system for SROs. At each stage from catchment to consumer (i.e. catchment, abstraction, conveyance, treatment, storage, distribution, and consumer) pre-mitigated risks are assessed using a 5x5 risk matrix, mitigation measures proposed, and resultant post mitigated residual risks assessed.

The framework methodology for this was developed by the All Company Working Group (ACWG)[1] and this report provides a summary of the outcome from the risk assessment framework approach.

This document summarises the changes to the SQWRA for LRU SRO between Gate 1 and Gate 2 which are as follows:

1. Review of new and updated information since Gate 1
2. Additional Limiting Hazards at Gate 2
3. SWQRA risk scoring methodology
4. Completion of the SWQRA
5. Gate 2 Risk Assessment outcome

The methodologies and results of the SQWRA have been discussed with the company drinking water quality team.

Risk assessment Scenarios

The following risk assessment (RA) scenarios have been undertaken considering a catchment through to consumer's tap approach, described above, aligned with the Drinking Water Safety Planning methodology:

- Teddington Direct River Abstraction (DRA) scheme
- Mogden Water Recycling and Mogden South Sewer schemes
- Beckton Water Recycling scheme

These RAs were undertaken in Gate 1 and are updated in this Gate 2 work.

Limiting Hazards at Gate 2

Gate 1 limiting hazards were reassessed at Gate 2 as well as any additional limiting hazards included in the Gate 2 SQWRA based on the new or updated information: Water quality (WQ) data, Drinking Water Safety Plans (DWSP), reg 28 reports and process flow diagrams (PFD).

Teddington DRA scheme

The following hazards were retained from Gate 1 work for Gate 2 assessment

- *Escherichia coli* (*E.coli*), *Cryptosporidium*, Nitrate, Nitrite, Cyanide, 1,4–Dioxane, Pathogens (bacteria, viruses, protozoa), Chloride, Chromium, Perfluorooctanesulfonic acid (PFOS), Perfoluorooctanoic acid (PFOA), Metaldehyde

Additional limiting hazards at Gate 2 were identified:

- Iron, Polycyclic Aromatic Hydrocarbons (PAH), Benzo(a)pyrene, N-Nitrosodimethylamine (NDMA), Total Organic Carbon (TOC), Ammonium, Turbidity, Aluminium, Total Pesticides, Corrosivity, Change in Source Type

[1] Strategic WQ Risk Framework – Report for All Company Working Group, Jacobs, 2021

Mogden Water Recycling and Mogden South Sewer schemes

The following hazards were retained from Gate 1 work for Gate 2 assessment

- *E.coli*, *Cryptosporidium*, Nitrate, Nitrite, Corrosivity, Change in source type, 1,4-Dioxane, Pathogens (bacteria, viruses, protozoa), NDMA, Chloride, Chromium, PFOS, PFOA, Metaldehyde, Change in hardness/alkalinity.

Additional limiting hazards at Gate 2 were identified:

- Iron, TOC, Turbidity, Aluminium, Lead, Manganese, Mercury, Nickel, Sodium, Total Pesticides, Benzo(a)pyrene.

Beckton Water Recycling scheme

The following hazards were retained from Gate 1 work for Gate 2 assessment

- *E.coli*, *Cryptosporidium*, Nitrate, Nitrite, Corrosivity, Change in source type, 1,4-Dioxane, Pathogens (bacteria, viruses, protozoa), NDMA, Chloride, Chromium, PFOS, PFOA, Metaldehyde, Change in hardness/alkalinity.

Additional limiting hazards at Gate 2 were identified:

- Iron, PAH, Benzo(a)pyrene, TOC, Ammonium, Turbidity, Aluminium, Total Pesticides.

Conclusions

The 4 SRO options considered at Gate 1 (Teddington DRA, Mogden Water Recycling, South Sewer and Beckton Water Recycling schemes) have been reassessed at Gate 2. Key conclusions from the Gate 2 assessment are:

- The Gate 1 SWQRA has been updated considering new water quality from SRO monitoring programme. As a result, some of the risk scores have changed between Gate 1 and Gate 2.
- New limiting hazards have been included at Gate 2 based on new water quality data and DWSPs.
- For several of the limiting hazards the residual risks posed to consumer are low (green). There are however a number of limiting hazards for which the residual risks to consumer remain high (red) or medium (amber). These are:
    (1) **Limiting hazards which pose a risk that consumers could experience a change in perception of their water**. These are generally related to change in source and include change in source type assessed as high risk (red) and change in alkalinity/hardness and corrosivity assessed as medium risk (amber). The mitigation is early consumer engagement which has been initiated. Corrosivity has been assessed for two aspects: the impact on network corrosion for which the mitigation is treatment/blending to minimise corrosion, and also the potential impact to taste and consumer perception for which the mitigation is consumer engagement.
    (2) **Limiting hazards related to Contaminants of Emerging Concern (CECs) - PFOS, PFOA, 1,4-Dioxane and NDMA.** These are mainly found in wastewater effluent and generally are difficult to treat with conventional treatment technologies employed for water and wastewater treatment. Advanced water treatment at Mogden and Beckton is to be provided to mitigate risk and reduce these CEC levels to within acceptable limits.

    For PFOS and PFOA, new guidance from DWI on PFAS in July 2022 requires monitoring of all 47 PFAS compounds opposed to only PFOS and PFOA. Additionally, the PFAS tiers have been altered to correspond to new sample result bands and new risk descriptions of low, medium and high. Under this new guidance PFOS and PFOA are assessed as amber risk, based on the data from SRO monitoring programme. Thames Water are currently monitoring for these contaminants however this data was not available for the Gate 2 assessment. This data should be reviewed at Gate 3.
    For 1,4-dioxane and NDMA, there is no water quality data available and no current guidance or drinking water standards from the DWI on these parameters. These have also been assessed as amber risk at this stage. It is recommended to carry out water quality sampling for these parameters and reassess the risks at Gate 3.

It is, however, recognised that global health advisories continue to change with regards to contaminants of emerging concern. In June 2022, the US Environmental Protection Agency (EPA) announced the release of health advisories for four perfluoroalkyl substances with extremely low concentration limits in drinking water of 0.004 parts per trillion (ppt) for PFOA and 0.02 ppt for PFOS. Compliance with these new US limits, if applied in the UK, will be very challenging for most water treatment works.

(3) **Limiting hazards have been assessed as a red or amber residual risk based on information in the DWSPs.** These include *Cryptosporidium*, Iron, Total Pesticides, Metaldehyde, Pathogens, – bacteria, viruses and protozoa, Benzo(a)pyrene, PAH, TOC, Ammonium, Turbidity, Aluminium, Lead and Mercury – These risks are already being mitigated via the current Thames Water DWSP process and are therefore not considered a high risk to these schemes going forward. However, it is noted that the treatment risk should be reviewed at Gate 3 as part of this scheme, based on the future water quality data, to ensure no impact to consumers going forward.

Contents

Acronyms and abbreviations

ACWG	All Company Working Group
CEC	Contaminants of Emerging Concern
CRI	Compliance Risk Index
DRA	Direct River Abstraction
DWI	Drinking Water Inspectorate
DWSP	Drinking Water Safety Plans
E.coli	*Escherichia coli*
INNS	Invasive non-native species
LRU	London Effluent Reuse Scheme
NDMA	N-Nitrosodimethylamine
PAH	Polycyclic Aromatic Hydrocarbons
PFD	Process Flow Diagram
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
RA	Risk Assessment
SRO	Strategic Resource Option
SWQRA	Strategic Water Quality Risk Assessment
STT	Severn to Thames Transfer
STW	Sewage Treatment Works
TOC	Total Organic Carbon
TWUL	Thames Water Utilities Limited
WQ	Water Quality

1. Introduction

The Strategic Water Quality Risk Assessment (SWQRA) provides a high-level risk assessment based on a drinking water safety approach to identify limiting hazards and assess their risks across the water supply system for Strategic Resource Options (SRO).

The framework methodology for this was developed by the All Company Working Group (ACWG)[2] and the key SWQRA outputs are a workshop providing overview and agreement on the Risk Assessment (RA) which are completed in excel form and used to provide summary information to Gate 2 reports and associated documents.

This document summarises the changes to the SQWRA for London Effluent Reuse SRO (LRU) between Gate 1 and Gate 2 which are as follows:

- Review of new and updated information
- Additional Limiting Hazards at Gate 2
- SWQRA risk scoring methodology
- Completion of the SWQRA template
- Revised Risk Scores

The methodologies and results of the SQWRA have been discussed with the company drinking water quality team.

[2] Strategic WQ Risk Framework – Report for All Company Working Group, Jacobs, 2021

2. Risk assessment scenarios

Three SWQRAs have been undertaken to cover the LRU:

- Teddington Direct River Abstraction (DRA) scheme
- Mogden Water Recycling and Mogden South Sewer schemes (one risk assessment for two schemes)
- Beckton Water Recycling scheme

These RAs were undertaken in Gate 1 and are updated in this Gate 2 work.

3. Limiting Hazards at Gate 2

The limiting hazards at Gate 2 included all the Gate 1 hazards plus additional hazards. These additional hazards were included based on new water quality data, which became available at Gate 2, as well as the Thames Water (TWUL) Drinking Water Safety Plans (DWSP). It was however considered that the number of WQ data points available at Gate 2 were not sufficient to exclude any of the Gate 1 limiting hazards although these could be reviewed at Gate 3 as more water quality data becomes available.

3.1 Limiting Hazards for Teddington DRA Scheme

3.1.1 Gate 1 hazards reconsidered at Gate 2

No limiting hazards assessed at Gate 1 were removed. Therefore, the following hazards were retained from Gate 1 work for Gate 2 assessment:

- *Escherichia coli* (*E.coli*), *Cryptosporidium*, Nitrate, Nitrite, Cyanide, 1,4–Dioxane, Pathogens (bacteria, viruses, protozoa), Chloride, Chromium, Perfluorooctanesulfonic acid (PFOS), Perfluorooctanoic acid (PFOA), Metaldehyde.

3.1.2 Additional limiting hazards included at Gate 2

The following limiting hazards were included in the Gate 2 SQWRA based on the above new or updated information. In particular, the new water quality monitoring data, which was not available at Gate 1, and literature and global best practice on contaminants of emerging concern (CEC) in water reuse projects.

Additional limiting hazards added in at Gate 2:

- Iron – Based on new water quality data.
- Polycyclic Aromatic Hydrocarbons (PAH) – Based on new water quality data.
- Benzo(a)pyrene – Based on new water quality data
- N-Nitrosodimethylamine (NDMA) – Likely to be present in wastewater effluent discharges and may be of risk at time of scheme operation. This is challenging to treat in advanced water recycling facilities and drinking water treatment etc.
- Total Organic Carbon (TOC) – Based on new water quality data.
- Ammonium – Based on new water quality data.
- Turbidity – Based on new water quality data.
- Aluminium – Based on new water quality data.
- Total Pesticides – Based on TWUL DWSP.
- Corrosivity – Based on inclusion of final effluent from Hogsmill STW which is from a new abstraction catchment not currently impacting the TLT
- Change in Source Type – Included as this may impact treatment and consumer acceptability.

3.2 Limiting Hazards for Mogden Water Recycling and Mogden South Sewer Schemes

3.2.1 Gate 1 hazards reconsidered at Gate 2

No limiting hazards assessed at Gate 1 were removed. Therefore, the following hazards were retained from Gate 1 work for Gate 2 assessment:

- *E.coli*, *Cryptosporidium*, Nitrate, Nitrite, Corrosivity, Change in source type, 1,4-Dioxane, Pathogens (bacteria, viruses, protozoa), NDMA, Chloride, Chromium, PFOS, PFOA, Metaldehyde, Change in hardness/alkalinity.

3.2.2 Additional limiting hazards included at Gate 2

Additional limiting hazards included at Gate 2 based on new information, as above, were:

- Iron – Based on new water quality data.
- TOC – Based on new water quality data.
- Turbidity – Based on new water quality data.
- Aluminium – Based on new water quality data.
- Lead – Based on new water quality data.
- Manganese – Based on new water quality data.
- Mercury – Based on new water quality data.
- Nickel – Based on new water quality data.
- Sodium – Based on new water quality data.
- Pesticides Total – Based on DWSPs.
- Benzo(a)pyrene – Based on new water quality data

Note - New water quality mentioned here refers to final effluent quality data for Mogden STW from SRO monitoring programme.

3.3 Limiting Hazards for Beckton Water Recycling Scheme

3.3.1 Gate 1 hazards reconsidered at Gate 2

No limiting hazards assessed at Gate 1 were removed. Therefore, the following hazards were retained from Gate 1 work for Gate 2 assessment:

- *E.coli*, *Cryptosporidium*, Nitrate, Nitrite, Corrosivity, Change in source type, 1,4-Dioxane, Pathogens (bacteria, viruses, protozoa), NDMA, Chloride, Chromium, PFOS, PFOA, Metaldehyde, Change in hardness/alkalinity.

3.3.2 Additional limiting hazards included at Gate 2

Additional limiting hazards included at Gate 2 based on new information, as above, were:

- Iron – Based on new water quality data.
- PAH – Based on new water quality data.
- Benzo(a)pyrene – Based on new water quality data.
- TOC – Based on new water quality data.
- Ammonium – Based on new water quality data.
- Turbidity – Based on new water quality data.
- Aluminium – Based on new water quality data.
- Total Pesticides – Based on TWUL DWSP.

Note - New water quality mentioned here refers to final effluent quality data for Becton STW from SRO monitoring programme.

4. Review of new and updated information for Gate 2

4.1 New Water quality Sampling Data

New water quality data, which was not available at Gate 1, was obtained to reassess the risks identified in the Gate 1 SWQRA. The data covers the sampling period from December 2020 to March 2022. Data until round 19 of the monthly spot sampling, dated 3.11.21 and from continuous sampling was included in the assessment.

4.2 Drinking Water Safety Plans (DWSP)

Thames Water's DWSPs relevant to the LRU SRO were obtained and reviewed to understand the existing risks identified in the DWSP.

4.3 Regulation 28 Reports

Regulation 28 reports were also reviewed to understand the outcome of the risk assessments carried out in the DWSPs and the mitigation measures undertaken to address risks to water quality highlighted.

4.4 Process Flow Diagrams (PFD)

PFDs of the Thames Water's water treatment works, which would abstract water from the LRU SRO, were reviewed to understand if the existing treatment processes at these works are suitable to address the risks posed by the limiting hazards identified in the SWQRA.

5. SWQRA Gate 2 Risk Scoring Methodology

5.1 General Approach

The general approach used for Gate 2 SWQRA risk scoring was as follows.

The template and RA methodology developed by the ACWG was applied which also provides general guidance for scoring of risk. An independent assessment of the risks was carried out by using a scoring methodology described in section 5.2. These scores were then compared with the risk scores in the water company's DWSPs, and the highest risk score adopted as the Gate 2 risk score. This procedure allowed for consistency with the water companies DWSP risk scores (Gate 1 approach) while allowing for these to be increased (a conservative approach) where the independent assessment considered the risk to be higher.

5.2 Gate 2 SWQRA Risk Scoring Methodology

ACWG methodology on SQWRA provides on overall framework of risk scores based on a 5X5 risk matrix using likelihood and consequence of risks as shown below in Figure 5-1.

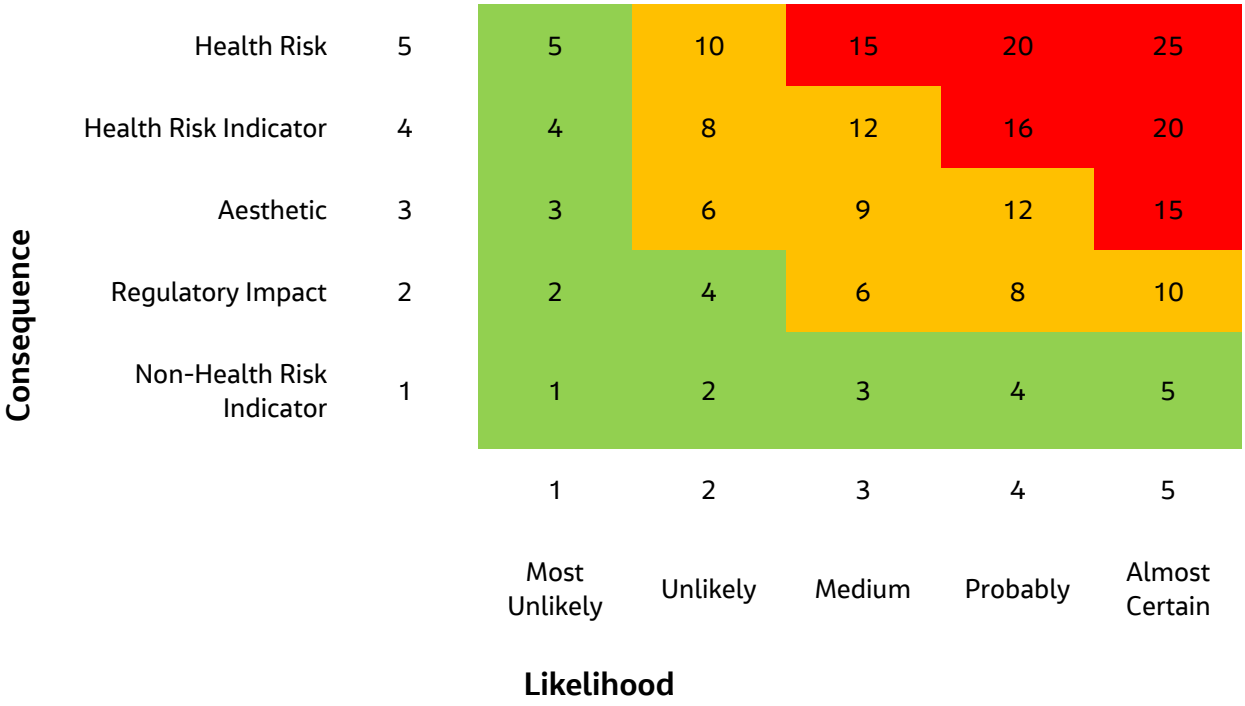


Figure 5-1: 5x5 Risk Matrix.

Different companies and consultants use varying definitions for consequence and likelihood. In this report, the following definitions for the likelihood and consequence scores were applied, as seen in Table 5-1 and Table 5-2.

Table 5-1: Likelihood scores definitions.

Score	Likelihood	Occurrence	Probability range (Failures in 5 years)
1	Most unlikely	< Once in 10 years	0,1
2	Unlikely	Once in 10 years	2,3,4
3	Medium	Annually	5-14
4	Probable	Monthly	15-59
5	Almost Certain	Daily	≥60

The consequence scores were defined based on *parameter scores* for contaminants included in the DWI's Compliance Risk Index (CRI) methodology. It is noted that the full CRI methodology, which is used to assess the impact of water quality compliance failures, is **not** applied here and only the parameter scores are used to assign a consequence score as seen in Table 5-2.

Table 5-2: Consequence scores definitions.

Score	Consequence	CRI Parameter Score
5	Health Risk	5
4	Health Risk Indicator	4
3	Aesthetic	3
2	Regulatory Impact	2
1	Non-Health Risk Indicator	1

6. SWQRA Gate 2 Pre-Mitigated Catchment Risk Scores and Changes from Gate 1

The following section provides a summary of Gate 2 SWQRA scores and changes in these from Gate 1. It also includes scores for new limiting hazards introduced at Gate 2 stage. Risk scores are broken down and shown as likelihood x consequence = overall.

6.1 Teddington DRA

Table 6-1 and Table 6-2 list the changes to pre-mitigated catchment risk scores between Gate 1 and Gate 2.
*Current data suggests Cyanide is not a risk within the River Thames upstream however following the scoring methodology, more water quality data at Teddington is required in order to reduce the score below that assigned at Gate 1. This will be reviewed at Gate 3.

Table 6-3 lists the scores for new limiting hazards included at Gate 2.

Table 6-1: Limiting hazards for which the risk scores have increased.

Limiting Hazard	Gate 1 Risk Score	Gate 2 Risk Score	Risk Score Change	Reason for Change
E.coli	4 x 5 = 20	5 x 5 = 25	Increased	WQ assessment
Nitrite	2 x 5 = 10	4 x 5 = 20	Increased	WQ assessment/DWSP
Metaldehyde	2 x 5 = 10	5 x 4= 20	Increased	DWSP
Pathogens	4 x 5 = 20	5 x 5 = 25	Increased	WQ assessment
Chromium	2 x 4 = 8	2 x 5 = 10	Increased	WQ assessment
PFOS	1 x 5 = 5	2 x 5 = 10	Increased	CEC
PFOA	1 x 5 = 5	2 x 5 = 10	Increased	CEC

Table 6-2: Limiting hazards for which the risk scores have not changed.

Limiting Hazard	Gate 1 Risk Score	Gate 2 Risk Score	Risk Score Change
Cryptosporidium	4 x 5 = 20	4 x 5 = 20	no change
Nitrate	3 x 5 = 15	3 x 5 = 15	no change
Cyanide*	2 x 5 = 10	2 x 5 = 10	no change
1,4-dioxane	3 x 4 = 12	3 x 4 = 12	no change
Chloride	3 x 3 = 9	3 x 3 = 9	no change

*Current data suggests Cyanide is not a risk within the River Thames upstream however following the scoring methodology, more water quality data at Teddington is required in order to reduce the score below that assigned at Gate 1. This will be reviewed at Gate 3.

Table 6-3: New limiting hazards included in Gate 2 SWQRA.

Limiting Hazard	Gate 1 Risk Score	Gate 2 Risk Score	Risk Score Change	Reason for Change
Iron	N/A	5 x 4 = 20	New	WQ assessment
PAH	N/A	4 x 4 = 16	New	WQ assessment
Benzo(a)pyrene	N/A	4 x 5 = 20	New	WQ assessment
Corrosivity	N/A	2 x 4 = 8	New	Change in water chemistry, Hogsmill effluent in new abstraction catchment
Change in source	N/A	3 x 5 = 15	New	Related to Consumer acceptance
NDMA	N/A	2 x 5 = 10	New	CEC
TOC	N/A	2 x 5 = 10	New	WQ assessment

Ammonium	N/A	3 x 4 = 12	New	WQ assessment
Turbidity	N/A	5 x 5 = 25	New	WQ assessment
Aluminium	N/A	4 x 5 = 20	New	WQ assessment
Pesticide: Total	N/A	4 x 4 = 16	New	Discussion with TWUL

6.2 Mogden Water Recycling and South Sewer

Table 6-4 and Table 6-5 list the changes to pre-mitigated catchment risk scores between Gate 1 and Gate 2. Table 6-6 lists the scores for new limiting hazards included at Gate 2.

Table 6-4: Limiting hazards for which the risk scores have increased.

Limiting Hazard	Gate 1 Risk Score	Gate 2 Risk Score	Risk Score Change	Reason for Change
Metaldehyde	3 x 5 = 15	5 x 4 = 20	Increased	DWSP
Change in Source	1 x 3 = 3	5 x 3 = 15	Increased	Related to Consumer acceptance
PFOS	1 x 5 = 5	2 x 5 = 10	Increased	CEC
PFOA	1 x 5 = 5	2 x 5 = 10	Increased	CEC

Table 6-5: Limiting hazards for which the risk scores have not changed.

Limiting Hazard	Gate 1 Risk Score	Gate 2 Risk Score	Risk Score Change
E.coli	5 x 5 = 25	5 x 5 = 25	no change
Cryptosporidium	5 x 5 = 25	5 x 5 = 25	no change
Nitrate	5 x 5 = 25	5 x 5 = 25	no change
Nitrite	4 x 5 = 20	4 x 5 = 20	no change
Corrosivity	3 x 4 = 12	3 x 4 = 12	no change
Change in hardness/Alkalinity	3 x 4 = 12	3 x 4 = 12	no change
1,4-dioxane	4 x 4 = 16	4 x 4 = 16	no change
Pathogens – Bacteria, Viruses, Protozoa	5 x 5 = 25	5 x 5 = 25	no change
NDMA	3 x 5 = 15	3 x 5 = 15	no change
Chloride	4 x 3 = 12	4 x 3 = 12	no change
Chromium	3 x 4 = 12	3 x 4 = 12	no change

Table 6-6: New limiting hazards included in Gate 2 SWQRA.

Limiting Hazard	Gate 1 Risk Score	Gate 2 Risk Score	Risk Score Change	Reason for Change
Iron	N/A	5 x 4 = 20	New	WQ assessment
TOC	N/A	2 x 5 = 10	New	WQ assessment/DWSP
Turbidity	N/A	5 x 5 = 25	New	WQ assessment
Aluminium	N/A	4 x 5 = 20	New	WQ assessment
Lead	N/A	3 x 4 = 12	New	WQ assessment
Manganese	N/A	4 x 4 = 16	New	WQ assessment
Mercury	N/A	3 x 5 = 15	New	WQ assessment
Nickel	N/A	1 x 5 = 5	New	WQ assessment*
Sodium	N/A	2 x 3 = 6	New	WQ assessment
Pesticide: Total	N/A	4 x 4 = 16	New	Discussion with TWUL
Benzo(a)pyrene	N/A	3 x 5 = 15	New	WQ assessment

*Nickel has been added as a limiting hazard due to WQ data. The scoring methodology applied results in a likelihood of 1 based on this data leading to a low score.

6.3 Beckton Water Recycling

Table 6-7 and Table 6-8 list the changes to risk scores between Gate 1 and Gate 2. Table 6-9 lists the scores for new limiting hazards included at Gate 2.

Table 6-7: Limiting hazards for which the risk scores have increased.

Limiting Hazard	Gate 1 Risk Score	Gate 2 Risk Score	Risk Score Change	Reason for Change
Change in Source	1 x 3 = 3	5 x 3 = 15	Increased	Related to Consumer acceptance
PFOS	1 x 5 = 5	2 x 5 = 10	Increased	CEC
PFOA	1 x 5 = 5	2 x 5 = 10	Increased	CEC

Table 6-8: Limiting hazards for which the risk scores have not changed.

Limiting Hazard	Gate 1 Risk Score	Gate 2 Risk Score	Risk Score Change
E.coli	5 x 5 = 25	5 x 5 = 25	no change
Cryptosporidium	5 x 5 = 25	5 x 5 = 25	no change
Nitrate	5 x 5 = 25	5 x 5 = 25	no change
Nitrite	5 x 5 = 25	5 x 5 = 25	no change
Metaldehyde	5 x 5 = 25	5 x 5 = 25	no change
Corrosivity	4 x 4 = 16	4 x 4 = 16	no change
Change in hardness/Alkalinity	4 x 4 = 16	4 x 4 = 16	no change
1,4-dioxane	4 x 4 = 16	4 x 4 = 16	no change
Pathogens – Bacteria, Viruses, Protozoa	5 x 5 = 25	5 x 5 = 25	no change
NDMA	3 x 5 = 15	3 x 5 = 15	no change
Chloride	4 x 3 = 12	4 x 3 = 12	no change
Chromium	3 x 4 = 12	3 x 4 = 12	no change

Table 6-9: New limiting hazards included in Gate 2 SWQRA.

Limiting Hazard	Gate 1 Risk Score	Gate 2 Risk Score	Risk Score Change	Reason for Change
Iron	N/A	4 x 5 = 20	New	WQ assessment
PAH	N/A	4 x 4 = 16	New	WQ assessment
Benzo(a)pyrene	N/A	4 x 4 = 16	New	WQ assessment
TOC	N/A	4 x 5 = 20	New	WQ assessment/DWSP
Ammonium	N/A	2 x 3 = 6	New	WQ assessment
Turbidity	N/A	5 x 4 = 20	New	WQ assessment
Aluminium	N/A	3 x 4 = 12	New	WQ assessment
Pesticide: Total	N/A	5 x 4 = 20	New	Discussion with TWUL

6.4 Contaminants of Emerging Concern (CEC)

It is noted that PFOS, PFOA, 1,4-dioxane and NDMA are CECs which are typically associated with wastewater.

New guidance from DWI on PFAS in July 2022 requires monitoring of all 47 PFAS compounds opposed to only PFOS and PFOA. Additionally, the tiers have been altered to correspond to new sample result bands and new risk descriptions of low, medium and high.

Based on available WQ data from the SRO monitoring programme and following the new guidance, the risk is considered medium from PFOS and PFOA if maximum values are assessed, and low if average values are used. Thames Water, at time of writing, inform that current WQ data available for PFOS/PFOA in the River Thames suggests the risk from these parameters is low however no detailed risk assessment has yet been carried out. This TWUL data was not available at the time of the Gate 2 assessment and so should be reviewed at Gate 3.

The risk for 1,4-dioxane and NDMA, is considered low however, as there was no monitoring data available the risk scores have been assessed as medium to reflect this uncertainty. There is no current guidance or drinking water standards from the DWI on these parameters. It is recommended to carry out water quality sampling for these parameters at monitoring points relevant to these schemes.

It is, however, recognised that global health advisories continue to change with regards to contaminants of emerging concern. In June 2022, the US Environmental Protection Agency (EPA) announced the release of health advisories for four perfluoroalkyl substances with extremely low concentration limits in drinking water of 0.004 parts per trillion (ppt) for PFOA and 0.02 ppt for PFOS. Compliance with these new US limits, if applied in the UK, will be very challenging for most water treatment works.

7. Post Mitigated Residual Risks in Water Supplied to the Consumers

The SQWRA process considers the risks to drinking water quality at all stages from catchment to the consumer. The risks are assessed at each stage of the process and mitigated where appropriate.

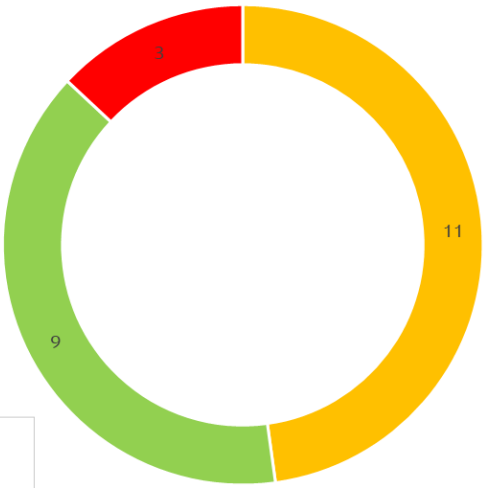
In the case of LRU several of the risks are mitigated at the treatment stage so that the residual risks posed to the consumer are low (green). There are however some limiting hazards for which the residual risks to consumer remain high (red) or medium (amber).

It is important to note that residual high risk scores are a product of two numbers: the worst case consequence score which remains unchanged progressing from catchment to consumer, and the worst case likelihood score at the consumer stage. This methodology was chosen to ensure consistency. Therefore, a hazard marked as high residual risk to the consumer for the purposes of this SWQRA does not necessarily correspond to a high risk to the consumers in current TWUL DWSPs. Where high risk scores are taken from DWSPs, it is considered that these risks are already being mitigated via the current TWUL DWSP process and so are not considered a high risk to these schemes going forward. However further review must take place at Gate 3.

7.1 Teddington DRA Residual Risks

The chart below shows the number of limiting hazards with red (high), amber (medium) and green (low) residual risks for Teddington DRA.

High (Red) risks include
Change in source type, *Cryptosporidium* and Pathogens – bacteria, viruses, and protozoa.



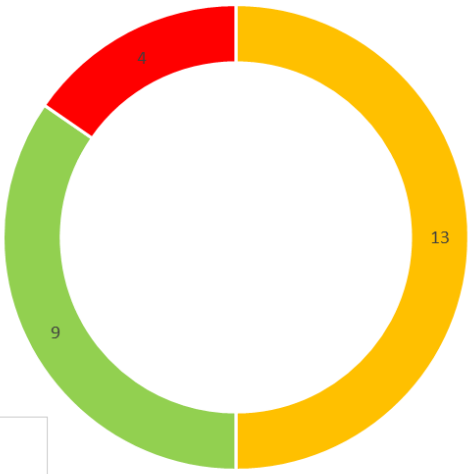
Medium (Amber) risks include:
Ammonium, Corrosivity, PAH, Benzo(a)pyrene, NDMA, PFOS, PFOA, 1,4-Dioxane, TOC, Metaldehyde and Pesticides total.

Low (Green) risks include:
Chloride, Iron, Aluminium, Chromium, Cyanide, *E.coli*, Nitrate, Nitrite and Turbidity.

7.2 Mogden Water Recycling and Mogden South Sewer Residual Risks

The chart below shows the number of limiting hazards with red (high), amber (medium) and green (low) residual risks for Teddington Mogden Water Recycling and Mogden South Sewer.

High (Red) risks include Change in source type, *Cryptosporidium*, Pathogens – bacteria, viruses and protozoa and Turbidity.



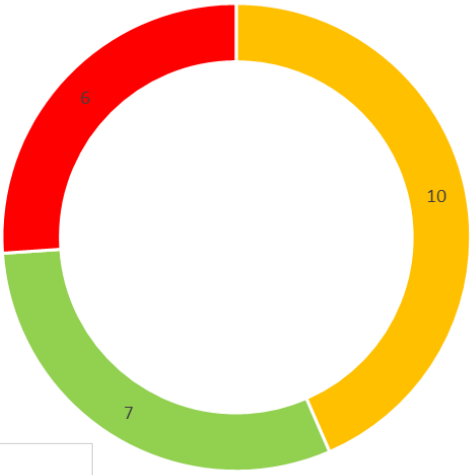
Medium (Amber) risks include: Iron, Benzo(a)pyrene, Mercury, NDMA, PFOS, PFOA, TOC, 1,4-dioxane, Change in hardness/Alkalinity, Corrosivity, Lead, Metaldehyde and Pesticides total.

Low (Green) risks include: Chloride, Sodium, Chromium, Manganese, Aluminium, *E.coli*, Nickel, Nitrate and Nitrite.

7.3 Beckton Water Recycling Residual Risks

The chart below shows the number of limiting hazards with red (high), amber (medium) and green (low) residual risks for Teddington Beckton Water Recycling.

High (Red) risks include Change in source type, *Cryptosporidium*, Metaldehyde, Pathogens – bacteria, viruses and protozoa, Benzo(a)pyrene and PAH.



Medium (Amber) risks include: Ammonium, Aluminium, NDMA, PFOS, PFOA, TOC, 1,4-dioxane, Change in hardness /Alkalinity, Corrosivity and Pesticides total.

Low (Green) risks include: Chloride, Chromium, Turbidity, *E.coli*, Iron, Nitrate, Nitrite.

8. Conclusions

Key conclusions from the Gate 2 assessment are:

- The 4 SRO options considered at Gate 1 (Teddington DRA, Mogden Water Recycling, South Sewer and Beckton Water Recycling schemes) have been reassessed at Gate 2.
- Gate 1 SWQRA has been updated considering new water quality from SRO monitoring programme. As a result, some of the risk scores have changed between Gate 1 and Gate 2.
- New limiting hazards have been included at Gate 2 based on new water quality data and DWSPs.
- For several of the limiting hazards the residual risks posed to the consumer are low (green). There are however a number of limiting hazards for which the residual risks to the consumer remain high (red) or medium (amber). These are:

Limiting hazards which pose a risk that consumers could experience a change in perception of their water. These are generally related to change in source and include change in source type assessed as high risk (red) and change in alkalinity/hardness and corrosivity assessed as medium risk (amber). The mitigation is early consumer engagement, and it is understood that this has started. Corrosivity has been assessed for two aspects: the impact on network corrosion for which the mitigation is treatment/blending to minimise corrosion, and also the potential impact to taste and consumer perception for which the mitigation is consumer engagement.

Limiting hazards related to CECs - PFOS, PFOA, 1,4-Dioxane and NDMA. These are mainly found in wastewater effluent and generally are difficult to treat. Advanced water treatment at Mogden and Beckton is to be provided to mitigate risk and reduce these CEC levels to within acceptable limits. Under the new DWI PFAS guidance, PFOS and PFOA have been assessed as amber risk, based on the data from SRO monitoring programme. Thames Water are currently monitoring for these contaminants however this data was not available during the Gate 2 assessment. This data should be reviewed at Gate 3. For 1,4-dioxane and NDMA, there is no water quality data available and no current guidance or drinking water standards from the DWI on these parameters. These have also been assessed as amber risk at this stage. It is recommended to carry out water quality sampling for these parameters and reassess the risks at Gate 3.

It is, however, recognised that global health advisories continue to change with regards to contaminants of emerging concern. In June 2022, the US Environmental Protection Agency (EPA) announced the release of health advisories for four perfluoroalkyl substances with extremely low concentration limits in drinking water of 0.004 parts per trillion (ppt) for PFOA and 0.02 ppt for PFOS. Compliance with these new US limits, if applied in the UK, will be very challenging for most water treatment works.

Other limiting hazards have been assessed as a red or amber residual risk based on information in the DWSPs. These include *Cryptosporidium*, Iron, Total Pesticides, Metaldehyde, Pathogens, – bacteria, viruses and protozoa, Benzo(a)pyrene, PAH, TOC, Ammonium, Turbidity, Aluminium, Lead and Mercury – These risks are already being mitigated via the current Thames Water DWSP process and are therefore not considered a high risk to these schemes going forward. However it is noted that the treatment risk should be reviewed in Gate 3 as part of this scheme based on the future water quality data at Teddington Weir to ensure no impact to consumers going forward.