Palm Paper Limited

SURFACE WATER POLLUTION RISK ASSESSMENT

Application to Vary Environmental Permit EPR/FP3132UE

SWPRA
JUNE 2026

CONFIDENTIAL

Palm Paper Limited

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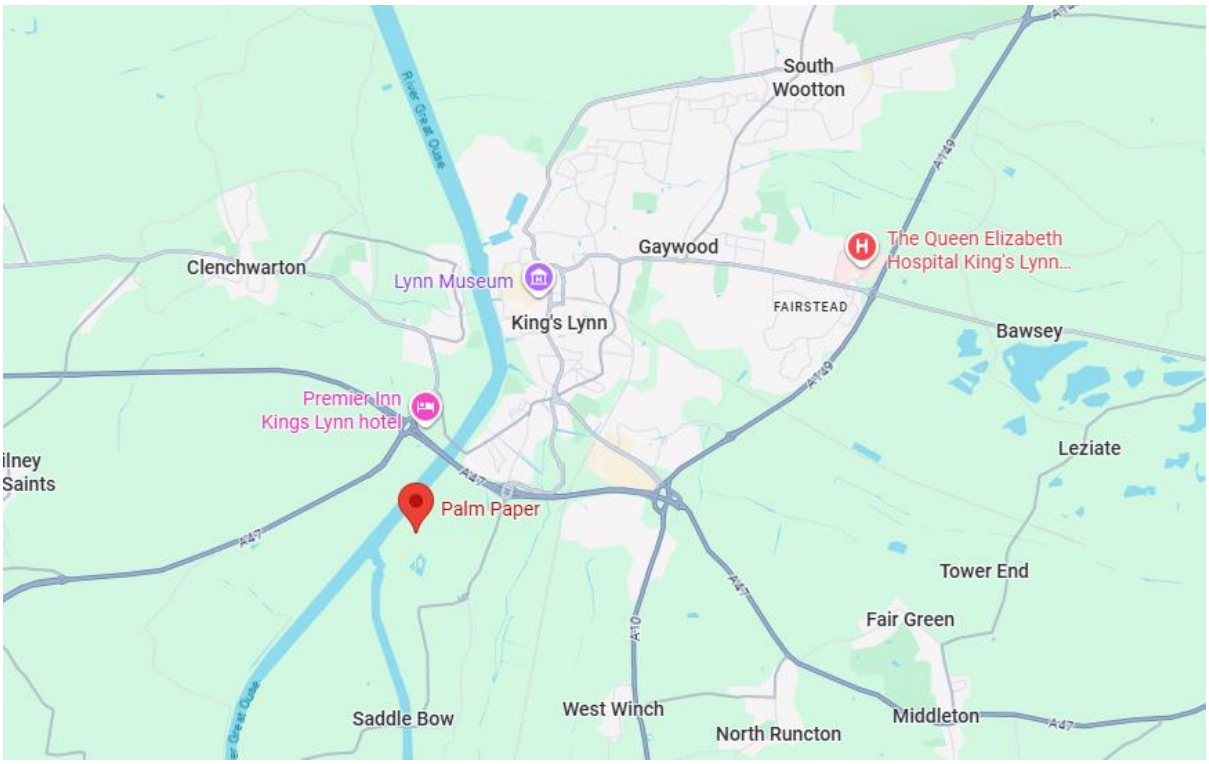
1 INTRODUCTION

1.1 BACKGROUND

Palm Paper Limited (hereinafter 'Palm Paper') is responsible for the operation of the Saddlebow Paper Mill, which is an integrated recovered paper facility which produces newsprint, from recycling newspaper and magazines, for sale into wholesale paper distributors and newspaper outlets. The site is located, as shown below in Figure 1, at Saddlebow Industrial Estate, on Poplar Avenue in the town of King's Lynn, Norfolk.

Figure 1 - Site Location Plan



Process effluent from the manufacturing process is directed through the Effluent Treatment Plant (ETP), undergoing biological wastewater treatment prior to discharge to the River Great Ouse. Palm Paper is seeking to vary its permit to reflect changes to the effluent treatment on site: up to four Anaerobic Reactors are to be installed to treat organic wastes in the effluent stream, as well as a biogas treatment system (BGTS) and coarse Biological Sulphur Removal (BSR).

This proposed project will also involve the use and utilisation of biomethane, extracted from the Anaerobic Reactors, for energy production. The intention of the project is to enable peak COD levels in final effluent to be reduced, as well as in a reduction in greenhouse gas emissions (CO_2), sludge production, organic loading on downstream aerobic systems (the aeration tanks and mixer aerator systems) and energy costs (via biomethane utilisation).

2 METHODOLOGY

This Surface Water Pollution Risk Assessment (SWPRA) has been undertaken in accordance with the Environment Agency's 'Surface water pollution risk assessment for your environmental permit'[1] guidance and Operational Instruction 'LIT 13134: Permitting of hazardous pollutants in discharges to surface water'[2].

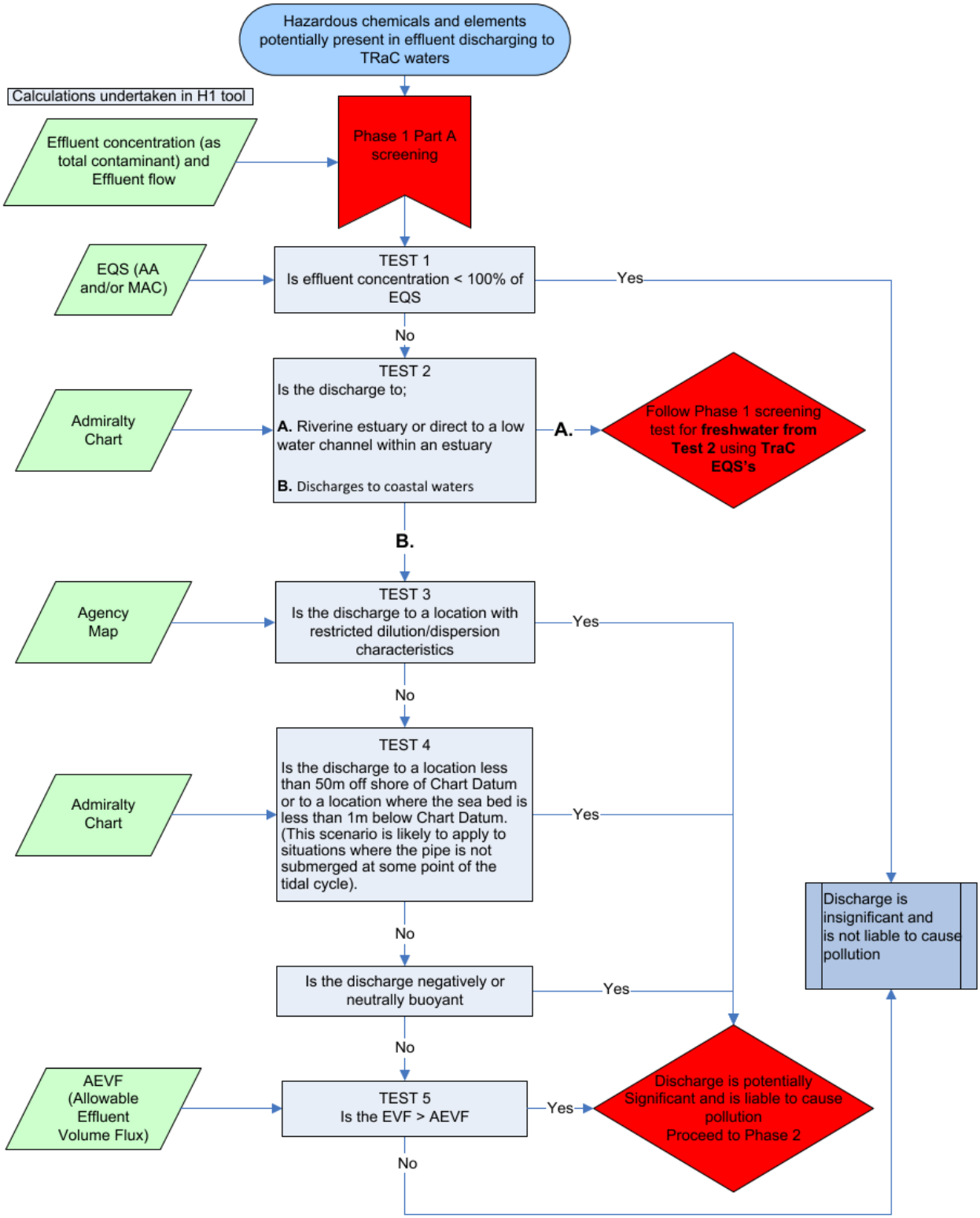
The referenced guidance is targeted at applicants for bespoke environmental permits that include the discharge of hazardous chemicals and elements to surface water. It describes a series of Screening Tests, designed to assess the risk from hazardous chemicals and elements to the environment, along with an additional test for priority hazardous pollutants to assess whether the annual load limit of pollutants discharged is greater than a defined significant load limit.

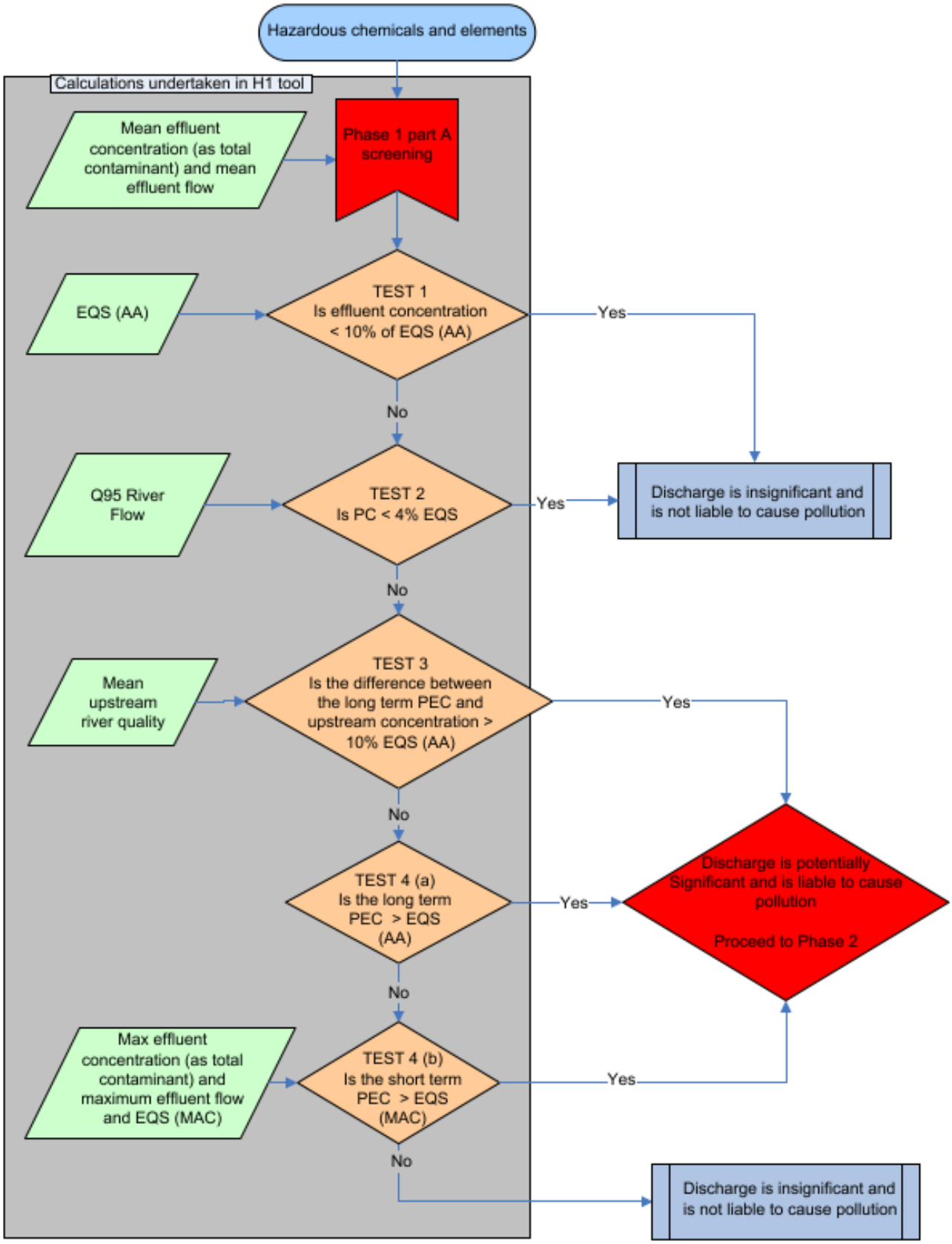
The equations described within the Screening Tests compare the nature of the effluent to be discharged, and the resultant quality within the receiving water course, with appropriate environmental quality standards (EQS). As the discharge location is coastal, Screening Tests for estuarine and coastal waters have been used for this risk assessment.

The equations used for each of the Screening Tests and for the Significant Load Assessment are presented below and summarised in Figure 2-1.

[1] Surface water pollution risk assessment for your environmental permit - GOV.UK – Published 01/02/2016, last updated 20/02/2026
[2] Operational Instruction LIT 13134: Permitting of hazardous pollutants in discharges to surface water – Published 20/06/2025

Figure 2-1 - Screening Tests for discharge to freshwater[2]




Hazardous chemicals and elements
Calculations undertaken in H1 tool
Mean effluent concentration (as total contaminant) and mean effluent flow
Phase 1 part A screening
EQS (AA)
TEST 1
Is effluent concentration < 10% of EQS (AA)
Yes
No
Q95 River Flow
TEST 2
Is PC < 4% EQS
Yes
Discharge is insignificant and is not liable to cause pollution
No
Mean upstream river quality
TEST 3
Is the difference between the long term PEC and upstream concentration > 10% EQS (AA)
Yes
No
TEST 4 (a)
Is the long term PEC > EQS (AA)
Yes
Discharge is potentially Significant and is liable to cause pollution
Proceed to Phase 2
No
Max effluent concentration (as total contaminant) and maximum effluent flow and EQS (MAC)
TEST 4 (b)
Is the short term PEC > EQS (MAC)
Yes
No
Discharge is insignificant and is not liable to cause pollution

2.1 SCREENING TEST 1

Screening Test 1 compares the concentration of the determinand in the discharge (the Release Concentration or "RC") to the relevant EQS. In the event that the RC of a determinand is less than the EQS, the determinand is considered not to pose an environmental risk and is screened out from further risk assessment. If the RC is greater than the EQS, the determinand is assessed further under Screening Test 2. The criteria for screening a determinand out from further risk assessment using Screening Test 1 is therefore defined by **Equation 1**.

Equation 1 - Screening Test 1

$$RC < EQS$$

In which:

RC = Maximum Release Concentration (µg/l); and

EQS = Environmental quality standard (µg/l).

2.2 SCREENING TEST 2

As the discharge point is to a Riverine Estuary, the following Screening Tests are Freshwater Screening Tests, starting from Test 2 using the EQS' associated with estuarine and coastal water.

Screening Test 2 introduces dilution within the receiving water body to calculate the Process Contribution (PC) (**Equation 2**). In the event that the PC of a determinand is less than 4 % of the EQS, the determinand is considered not to pose an environmental risk and is screened out from further risk assessment. If the Process Contribution (PC) of the determinand is greater than 4 % of the EQS, the determinand is assessed further under Screening Tests 3 and 4.

The criteria for screening out from further risk assessment using Screening Test 2 is therefore defined by **Equation 3**.

Equation 2 - Process Contribution

$$PC = \frac{EFR * RC}{EFR + RFR}$$

In which:

PC = Process Contribution (µg/l);

EFR = Effluent Flow Rate (m^3/s);

RFR = River Flow Rate (m^3/s);

RC = Release Concentration (µg/l).

Equation 3 - Screening Test 2

$$PC < 0.04 * EQS$$

In which:

PC = Process Contribution (µg/l);

EQS = Environmental Quality Standard (µg/l).

2.3 SCREENING TEST 3 AND 4

Screening Test 3 examines the difference between background water quality and the predicted environmental concentration (PEC) and the EQS. As the RFR is more than ten times the EFR, the PEC should be calculated as described in **Equation 4**.

Equation 4 - Predicted Environmental Contribution (If the RFR is more than ten times the EFR)

$$PEC = PC + BC$$

In which:

PEC = Predicted Environmental Concentration (µg/l);

PC = Process Contribution (µg/l) as defined in Equation 2;

BC = Background Concentration (µg/l).

The criteria for screening a determinand out from further risk assessment using Screening Test 3 is defined by Equation 5.

Equation 5 - Screening Test 3

$$PEC - BC < 0.1 * EQS$$

In which:

PEC = Predicted Environmental Concentration(µg/l);

BC = Background Concentration (µg/l);

EQS = Environmental Quality Standards (µg/l).

In addition to satisfying the criteria for Screening Test 3, to screen out a determinand at this stage, the criteria for Screening Test 4 must also be met simultaneously. This criteria is defined by **Equation 6.** The PEC must not be greater than the relevant determinand EQS.

Equation 6 - Screening Test 4

$$PEC < EQS$$

In which:

PEC = Predicted Environmental Concentration (µg/l);

EQS = Environmental Quality Standards (µg/l).

2.4 SIGNIFICANT LOAD ASSESSMENT

The guidance also states that additional screening should be carried out for priority hazardous pollutants to assess whether the annual load limit of pollutants discharged is greater than the significant load limit. The significant load of a pollutant is calculated using **Equation 7** and is subsequently compared to the relevant significant load limit.

Equation 7 - Significant Load Assessment

$$SL = \frac{Days\ operational * RC * EFR}{10^9}$$

In which:

SL = Significant Load (Kg/year);

RC = Release Concentration (µg/l);

EFR= Effluent Flow Rate (m^3/day).

3 SCREENING TEST INPUTS

The following sections describe the input data used within the Screening Tests to inform this SWPRA.

3.1 ENVIRONMENTAL QUALITY STANDARDS

The Screening Tests compare the measurements of pollutants to be discharged to Environmental Quality Standards (EQS). There are two types of EQS:

- EQS Annual Average (AA) – to evaluate the long-term environmental impacts that could be caused; and
- EQS Maximum Allowable Concentrations (MAC) – to evaluate the short-term environmental impacts that could be caused.

AS PALM PAPER IS DISCHARGING TO THE RIVERINE ESTUARY, THE RELEVANT EQSS FOR ESTUARINE AND COASTAL WATER HAVE BEEN USED FOR THIS ASSESSMENT. COPPER

The EQS concentration for Copper – Dissolved is determined from the amount of Dissolved Organic Carbon (DOC) in the estuary.

Table 3-1 - EQS Copper - Dissolved

DOC Scenario	Annual average environmental quality standard (µg/l)
< 1 mg/l	3.76
> 1 mg/l	See **Equation 8** below

Equation 8 - EQS Copper - Dissolved

$$Average\ EQS\ for\ Copper - Dissolved = 3.76 + (2.677x\ ((DOC/2))\mu g/l$$

The level of DOC in the background concentration is unknown and so the EQS for a DOC of < 1 mg/l has been used, as this presents a worst-case scenario and a more rigorous test.

ZINC

The EQS concentration for Zinc – Dissolved is determined based on the ambient background concentration of Zinc, as per the equation below:

Equation 9 - EQS Zinc - Dissolved

$$Average\ EQS\ for\ Zinc - Dissolved = 6.8 + Ambient\ Background\ Concentration$$

It should be noted that for saltwater, an Ambient Background concentration of 1.1 µg/l is recommended. The EQS for this scenario has been calculated from background concentration of zinc, from the Environment Agency Water Quality Explorer as described in Section 3.4.

3.2 INDICATIVE RELEASE CONCENTRATION OF THE EFFLUENT

Bi-annual monitoring data of effluent has been used to inform this SWPRA. The sample, taken on 11/12/2025, has been analysed by ALS Laboratories UK Limited via UKAS-accredited testing services. Given that, as a result of the proposed changes to effluent treatment on site, there are to be no additional emissions to water, such data has been used for this assessment.

In accordance with the GOV.UK's guidance[1], any samples recorded as less than the limit of detection (LOD), will be treated as the LOD. This is therefore a conservative approach which reflects the worst-case scenario.

This assessment is only considering the treated effluent from the ETP and not the surface water runoff from the drainage system (uncontaminated).

3.3 EFFLUENT FLOW RATE

The maximum rate of discharge from the ETP for July to December 2025 (based on bi-annual monitoring) is a continuous flow at 13625 m^3 / day or 0.158 m^3 / s.

RIVER FLOW RATE

The Environment Agency's guidance recommends that a Q95 river flow is used as the river flow rate (RFR) for the receiving water course. The Q95 is the flow in the watercourse which is exceeded by 95 % of the recorded flows which comprises a conservative low flow representing a low degree of dilution.

The River Great Ouse is an ungauged watercourse and therefore, for this assessment the RFR was calculated by Wallingford HydroSolutions LTD (WHS)[3] using the Qube water resource modelling system developed by WHS in partnership with the Environment Agency. Qube is used as a best practice tool for the estimation of flows in ungauged catchments by the EA, Natural Resources Wales, Scottish Environment Protection Agency, Northern Ireland Environment Agency, Environmental Protection Agency and the UK water industry. The complete WHS report is included within Appendix A of this Risk Assessment.

The Q_{95} of the River Great Ouse is estimated to 7.416 m^3/s, or 640,742.4 m^3/day.

3.4 BACKGROUND DATA

Background data for the River Ouse has been sourced from the Water Quality Explorer[4] and these sampling points are summarised below.

Table 3-2 – Background Data

[3] Qube Flow Estimation Service – WHS
[4] Map Explorer | Water Quality Explorer

Description	R.OUSE FREEBRIDGE KINGS LYNN[5]	RIVER OUSE FREEBRIDGE KINGS LYNN LOW WATER[6]
Sampling Point ID	AN-57M01	AN-57M01L
Type	SALINE WATER - ESTUARINE SITES - NON BATHING/SHELLFISH	SALINE WATER - ESTUARINE SITES - NON BATHING/SHELLFISH
Region	Anglian	Anglian
Area	ANGLIAN - CAMBS AND BEDFORDSHIRE	ANGLIAN - CAMBS AND BEDFORDSHIRE
Date of samples	May-2021 – May 2026	

In accordance with GOV.UK Guidance[1], when not available, a background concentration of 50% of the EQS has been assumed. Table 3-3 below shows the background concentration for the relevant substances identified in the effluent to be discharged.

Table 3-3 - Background Concentration Data

Substance	Background Data (µ / l)
Arsenic (dissolved)	2.27
Cadmium and its compounds (dissolved)	0.0402
Chloride	1477.16
Chlorpyrifos (chlorpyrifos-ethyl)	0.00225
Chromium (VI) (dissolved)	0.422
Copper - dissolved	1.99
Cypermethrin	0.00006525

[5] Sampling Point AN-57M01 | Water Quality Explorer
[6] Sampling Point AN-57M01L | Water Quality Explorer

Lead and its compounds (dissolved)	0.311
Mercury and its compounds (dissolved)	0.0292
Nickel and its compounds (dissolved)	3.622
Pentachloro-phenol	0.02
Zinc - dissolved	4.70

4 RESULTS

The results from Screening Tests 1-4 for Phase 1 and Phase 2 are included in Appendix C and D respectively.

Of the 'hazardous chemicals and elements' listed on the GOV.UK[1] guidance, 22 of these substances were identified as present or potentially present in the groundwater monitoring data discussed in Section 3.2.

4.1 SCREENING TEST 1

Of the 22 substances screened in Screening Test 1, 10 were screened out from further testing, chloride, manganese and sulphate do not have an associated EQS, and 9 were carried forward to Screening Test 2 for further testing.

4.2 SCREENING TEST 2

Of the 9 substances screened in Screening Test 2, 2 were screened out from further testing, and 4 were carried forward to Screening Test 3 & 4 for further testing.

4.3 SCREENING TEST 3 AND 4

Of the 4 substances screened in Screening Test 3 and 4, 0 were screened out from further testing, and all 4 could not be screened out. Therefore, they may require further modelling (to be determined by EA in accordance with the Gov.UK guidance[1]).

4.4 SIGNIFICANT LOAD ASSESSMENT

All substances detected with a significant load limit must undergo additional screening against this limit must be assessed regardless of whether or not the determinand has previously been screened out in Tests 1-4. 4 of the 22 substances present in the effluent have an associated significant load limit. Of the 4 analysed determinands that have a significant load limit, all 4 passed and therefore do require additional modelling as a result of the Significant Load Assessment, as shown below in Table 4-1.

Table 4-1 – Significant Load Assessment

Determinand	Annual Significant Load Limit in Kg	Annual Load in Kg
Anthracene	5	Not measured in effluent
Brominated diphenyl ether	1	Not measured in effluent
Cadmium	5	0.0994625
Chloroalkanes	1	Not measured in effluent
Dioxins	0.0001	Not measured in effluent
Endosulphan	1	Not measured in effluent
Hexachlorobenzene	1	Not measured in effluent
Heptachlor	1	Not measured in effluent
Hexachlorobutadiene	1	Not measured in effluent
Hexachloro-cyclohexane	1	Not measured in effluent
Mercury and its compounds	1	0.00000575593
Nonylphenol (4-Nonylphenol)	1	0.00000287797
Pentachloro benzene	1	Not measured in effluent
Polycyclic aromatic hydrocarbons	5	Not measured in effluent
Tributyltin compounds (Tributyltin-cation)	1	0.00000575593

4.5 SUBSTANCES NOT SCREENED OUT

Table 4-2 identifies the substances that have not been screened out as a result of Screening Tests 1-4 and the Significant Load Assessment. All of these substances, with the exception of Perfluorooctane sulfonic acid and its salts (PFOS), were measured in the groundwater as below the LoD. Therefore, in accordance with the GOV.UK guidance, these have been treated as equal to the LoD and therefore could not be screened out.

Table 4-2 – Substances which failed Screening Tests 1-4

Substance	Maximum concentration measured in effluent (µg/l)[7],[8]	Comment
Cypermethrin	0.006	Results obtained are below the LoD and therefore have been assumed to be equal to LOD in accordance with GOV.UK[1] guidance.
Pentachloro-phenol	2.5	Results obtained are below the LoD and therefore have been assumed to be equal to LOD in accordance with GOV.UK[1] guidance.
Perfluorooctane sulfonic acid and its salts (PFOS)	0.0097	Given that this could not be screened out, this may be subject to additional screening by the EA.
Tributyltin compounds (Tributyltin-cation)	0.1	Results obtained are below the LoD and therefore have been assumed to be equal to LOD in accordance with GOV.UK[1] guidance.

[7] This data was collected from bi-annual monitoring of effluent from July – December 2025 and was analysed by ALS Laboratories UK Limited. This is further detailed in Section 3.2

[8] Refer to Appendix B for the original bi-annual monitoring data including Limit of Detections.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

This SWPRA has been prepared to examine the proposed changes to the ETP at the Paper Mill and the impacts on the effluent to be discharged. The analysis undertaken includes:

- Screening Tests 1-4 as described within the GOV.UK guidance[1];
- Significant Load Assessment as described within the GOV.UK guidance[1].

The SWPRA has shown that:

- Using the available effluent quality data, 4 of 22 determinands identified have failed the screening assessments and may require further assessment.
- Of these 4 substances that could not be screened out, 3 were recorded below the LoD and could not be screened out as a result. However, the available data set is not currently sufficient to draw this conclusion in line with the GOV.UK guidance[1] which requires that the minimum reporting value be <10% of the EQS.
- None of the determinands fail the Significant Load Assessment.
- Given that 4 substances could not be screened out, these may be subject to additional screening from the EA.

5.2 RECOMMENDATIONS

It is recommended that Palm Paper continue their monitoring regime in line with the Waste Treatment BAT Conclusions[9], in particular:

- BAT 3 to establish and to maintain an inventory of waste water as part of the environmental management system;
- BAT 6 and BAT 7 regarding the monitoring regime.

Once the Anaerobic Reactors are operational, a wastewater inventory of hazardous chemicals and elements should be produced using the usual annual sampling regime, and this list used to refine the results of this SWPRA.

[9] Waste Treatment | EU-BRITE

Appendix A

WHS FLOW ESTIMATE

Appendix B

MONITORING RETURNS BI-ANNUAL HAZARDOUS POLLUTANTS SCREEN AND METAL ANALYSIS DISCHARGE JUL-DEC 2025

Appendix C

SCREENING TEST

Table C– Screening Tests Results

							Test 1		Test 2							Test 3		Test 4		
Substance	Discharge Average(ug/l)	Discharge Maximum	AA EQS (ug/l)	MAC EQS (ug/l)	AA BC	MAC BC	Is conc> AAEQS?	Is conc. > MAC EQS?	MEAN PC	MAX PC	Is PC. >4 % of AA EQS?	Is PC. >4 % of MAC EQS?	Screening Test 2 requires further screening	PEC - BC (Mean)	PEC - BC (Max)	Is PEC -BC >10 % of AA EQS?	Is PEC -BC >10 % of MAC EQS?	Is PEC> AA EQS	IS PEC>MAC EQS	Does the determin and require modelling
Arsenic (dissolved)	2.16	2.16	25	Not applicable	12.5	Not applicable	No	No												NO
Boron	812	812	7000	Not applicable	3500	Not applicable	No	No												NO
Cadmium and its compounds (dissolved)	0.02	0.02	0.2	Not applicable	0.1	Not applicable	No	No												NO
Chloride	1190000	1190000	Not applicable	Not applicable	Not applicable	Not applicable	No	No												NO
Chlorpyrifos (chlorpyrifos-ethyl)	0.003	0.003	0.03	0.1	0.015	0.05	No	No												NO
Chromium (VI) (dissolved)	2.53	2.53	0.6	32	0.3	16	Yes	No	0.05267874					0.05267874						NO
Cobalt (dissolved)	5.73	5.73	3	100	1.5	50	Yes	No	0.119307976		NO			0.119307976						NO
Copper - dissolved	40	40	3.76	Not applicable	1.88	Not applicable	Yes	No	0.832865451		YES			0.832865451						NO
Cypermethrin	0.006	0.006	0.000008	0.00006	0.000004	0.00003	Yes	Yes	0.00012493	0.000137249	YES	YES	YES	0.00012493	0.000137249	YES		YES		YES
Iron (dissolved)	90	90	1000	Not applicable	500	Not applicable	No	No												NO
Lead and its compounds (dissolved)	0.3	0.3	1.3	14	0.65	7	No	No												NO

Manganese	78.9	78.9	Not applicable	Not applicable	Not applicable	Not applicable	No	No											NO
Mercury and its compounds (dissolved)	0.1	0.1	Not applicable	0.07	Not applicable	0.035	No	Yes		0.002287484		NO	NO		0.002287484				NO
Nickel and its compounds (dissolved)	4.7	4.7	8.6	34	4.3	17	No	No											NO
Nonylphenol (4-nonylphenol)	0.05	0.05	0.3	2	0.15	1	No	No											NO
Octylphenol (4-(1,1',3,3'-tetramethyl-butyl)-phenol)	0.05	0.05	0.01	Not applicable	0.005	Not applicable	Yes	No	0.001041082		YES	NO	NO	0.001041082					NO
Pentachloro-phenol	2.5	2.5	0.4	1	0.02	0.02	Yes	Yes	0.052054091	0.057187091	YES	YES	YES	0.052054091	0.057187091	YES	YES	NO	NO	YES
Perfluorooctane sulfonic acid and its salts (PFOS)	0.0097	0.0097	0.00013	7.2	0.000065	3.6	Yes	No	0.00020197		YES	YES	YES	0.00020197		YES		YES		YES
Sulphate	278000	278000	Not applicable	Not applicable	Not applicable	Not applicable	No	No											NO
Tributyltin compounds (tributyltin-cation)	0.1	0.1	0.0002	0.0015	0.0001	0.00075	Yes	Yes	0.002082164	0.002287484	YES	YES	YES	0.002082164	0.002287484	YES		YES		YES
Vanadium	10.5	10.5	100	Not applicable	50	Not applicable	No	No											NO
Zinc - dissolved	6.6	6.6	11.49787879	Not applicable	5.748939	Not applicable	No	No											NO

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