

ENVIRONMENTAL PERMIT APPLICATION- Bespoke Risk Assessment

SITE NAME	Llangennech Train Derailment Site
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REVIEWS AND REVISIONS

REVISION NUMBER	DATE	DETAILS	CONSULTANT

1 INTRODUCTION

In August 2020, following a train derailment, an estimated 250,000 to 400,000 litres of diesel was lost to the environment near Llangennech, Carmarthenshire. The fuel loss impacted the local ground, groundwater, surface watercourses and the wider Loughor Estuary, a highly sensitive saltmarsh and intertidal zone comprising river and estuarine environments that are protected under various statutory instruments.

Adler and Allan (A&A) has led the environmental response works, including the recovery of oil from the train wagons, recovery of oil from the environment, the installation of an extensive network of containment measures to limit the migration of oil, and monitoring, sampling and surveying of the area.

Subsequent site investigation has been undertaken to inform the environmental risk assessment and a proposed remediation strategy has been submitted to NRW, there are ongoing refinements of the remediation strategy as further investigation is ongoing. The strategy outlined and agreed with NRW to date involves the removal of source impacted soil by excavation, as part of these works and the subsequent longer term strategy to remove/contain/monitor any residual impacts, management of the surface water flows across the site will be required.

Adler&Allan are applying for a Bespoke Environmental Permit for the purpose of management of surface water discharges at the site whilst undertaking remediation.

The reports relating to site investigations that have been issued to date are set out in the non-technical summary.

A environmental risk assessment for the site is provided in the preliminary risk assessment report, in addition, site activities have evolved since this report as works move to the initial phases of remedial works at the site as set out in the remedial strategy for the site (see non-technical summary for details). An updated risk assessment is therefore provided in Appendix A of this document to reflect this and to comply with the requirements of the permit application.

2 SCREENING TESTS

2.1 Identify the pollutants released from your discharge

The pollutants were identified by consideration of the sources from the site, this included those likely to have derived from the diesel spill and in addition metals due to the proximity of the mine water treatment works and historic contaminants (site used for mine waste storage, railway sidings and potential mine water upwellings), historic contaminants were considered only in the context of potential further mobilisation as a result of the remedial works. A summary of the contaminants of concern are set out below.

Source	Contaminants of Concern
Accidental loss of Diesel resulting from train de-railment.	Total Petroleum Hydrocarbons Critical Working Group (TPH CWG), Volatile Organic Compounds (VOC) and Polycyclic Aromatic Hydrocarbons (PAH).
Remobilisation of historic contaminants of concern as a result of the remedial excavation works.	Dissolved and total metals.

Of the compounds identified as being analysed for within these suites, the following specific pollutants, priority and other substances that are considered to be hazardous pollutants are listed below, note those not included but determined to be hazardous by the Joint Agencies Groundwater Directive Advisory Group are also included. Where EA minimum reporting values are available, they are given in square brackets.

- Arsenic
- Chromium III
- Iron
- Cadmium [0.1 µg/l]
- Lead
- Mercury [0.01 µg/l]
- Nickel
- Naphthalene
- Anthracene
- Acenaphthene
- Benzo(a)pyrene
- Indeno(123cd)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Fluoranthene
- Benzo(ghi)perylene
- Benzene
- Carbon Tetrachloride [0.1 µg/l]
- 1,2-dichloroethane
- Dichloromethane
- Hexachlorobutadiene [0.005 µg/l]

- Toluene
- Ethylbenzene
- Tetrachloroethene [0.1 µg/l]
- Tetrachloroethane
- Trimethylbenzenes
- Trichlorobenzenes [0.01 µg/l]
- Trichloroethylene
- Trichloroethane
- Tetrachlorobenzene
- Dichlorobenzenes
- Dichloropropane
- Dibromoethane
- 1,2-dichloropropane
- Styrene
- 4-Chlorotoluene
- Trichloromethane (chloroform) [0.1 µg/l]
- Xylenes

The following non hazardous substances where an EQS is available have also been considered for screening;

- Boron
- Cobalt
- Copper
- Silver
- Vandium
- Zinc
- Tin
- 1,1,1-trichloroethane[0.1 µg/l]
- 1,1,2-trichloroethane[0.1 µg/l]
- 1,2-dichloroethane [1 µg/l]
- Fluoride
- pH

2.2 Data Gathering

Sampling is regularly undertaken on surface water monitoring points at the site as part of the monitoring programme for the incident management and continuing site investigation/remedial works. This programme nominally included analysis for metal, TPHCWG, BTEX, MTBE, Chloride, Fluoride, sulphate, Nitrite, Nitrate, Phosphate, Alkalinity and pH. Data was available for these determinants from August 2020 (except for pipe dam 3 and 4 which were not part of the original programme).

The programme was adapted in order to collect samples that would be representative of the discharge from the northern and southern ditches where the interceptors are proposed to be installed (Pipe Dam 3 and 4) as well as upstream (SW5) and downstream (SW4) sampling in the receiving waters (Afon Morlais).

Sampling for the additional determinants required for the purpose of the permit application commenced on the 12th November and are currently available up until the 16th December 2020.

Samples were collected in appropriate containers and submitted to a UKAS accredited Laboratory (Element Materials Technology) for analysis.

During sampling water quality parameters were measured (Dissolved Oxygen, Redox Potential, pH, Total Dissolved Solids, Salinity, Temperature and Conductivity) with an multiple parameter probe.

The tabulated results of the analysis are presented in Appendix B. The tables include the calculated minimum, maximum and average values, where the result was below detection, the limit of detection was used to calculate the average.

The tables include the EQS for estuaries and coastal waters, as the stretch of the Afon Morlais is within the designation of the transitional waters of the Loughor Estuary. Minimum reporting values for determinants are included within the tables where available.

Flow rates were obtained at the discharge points, this was undertaken with a flow meter that takes an average over 4 minutes, this was prior to the installation of the interceptor in the southern ditch. Currently flow is being diverted away as part of the surface water management onsite during the remedial works and removed for disposal to prevent discharge to the Afon Morlais (until such time a permit is obtained), it is not possible at present to give an accurate average/maximum flow rate given the present activities onsite.

2.3 Screening Test

Following discussion with NRW the following approach was agreed.

- The data supplied needed to cover any chemicals that would reasonably be expected to be in this type of discharge. Including the metals that have been identified or would be expected given the historic use of the area;
- For the H1 risk assessment, the 'TraC' EQS should be used in all tests;
- Should Test 1 fail for any substance then (due to discharging to the low water channel) the rest of the assessment should follow the freshwater screening/modelling steps, but applying the TraC EQS' rather than the freshwater ones listed on the Surface Water Risk Assessment Guidance;

- Completing screening/modelling at the point the Morlais reaches the Loughor due to the short distance the effluent will travel in the Morlais, though part of the same WFD transitional watercourse, different receptors need to be considered further down the Loughor. Note partial data was available from SW3 (dissolved metals and TPH, BTEX and MTBE) which has not been safe to access during the sampling period, downstream data was used for the remaining determinants for screening (SW4), located 15m downstream of discharge point PD3 and upstream of the confluence between the Morlais/Loughor;
- Priority hazardous substances may be of concern. Whether or not the substances identified failed in any of the previous tests, Part B screening will be required as detailed by the EA; and
- If by the end of the H1 Risk assessment any substance has failed to screen out, it will be for NRW to carry out further assessment/modelling to establish and include conditions to control the hazardous chemical or element in a permit.

The screening tests were undertaken with use of the H1 risk assessment tool. Pipe dam 3 and 4 discharges were screened together, screening for the point the Morlais reaches the Loughor has been undertaken separately as this does not represent any additional discharge rather consideration of the different receptors.

2.4 Results of screening test

Test 1 PD3/PD4- The following substances have failed test 1:

- Anthracene (PD3 and PD4)
- Benzo (b) fluoranthene (PD3 and PD4)
- Benzo (ghi) perylene (PD3 and PD4)
- Benzo (k) fluoranthene (PD3 and PD4)
- Fluoranthene (PD3 and PD4)
- Indeno (123-cd) pyrene (PD3 and PD4)
- Lead (PD3 and PD4)
- Mercury (PD3 and PD4)
- Zinc (PD3 and PD4)
- Cobalt (PD4)
- Iron (PD4)
- Benzo (a) pyrene (PD4)

Test 2 PD3/PD4- The following substances have failed test 2:

- Anthracene
- Benzo (a) pyrene
- Benzo (b) fluoranthene
- Benzo (ghi) perylene
- Benzo (k) fluoranthene
- Indeno (123-cd) pyrene

- Fluoranthene
- Cobalt
- Copper
- Iron
- Lead
- Mercury
- Nickel
- Trichloromethane
- Zinc

Test 3 PD3/PD4- The following substances have failed test 3:

- Benzo (a) pyrene
- Benzo (b) fluoranthene
- Benzo (ghi) perylene
- Benzo (k) fluoranthene
- Indeno (123-cd) pyrene
- Fluoranthene
- Copper
- Iron
- Lead
- Mercury
- Nickel
- Trichloromethane
- Zinc

Test 4 PD3/PD4- The following substances have failed test 4:

- Benzo (a)pyrene
- Benzo (b) fluoranthene
- Benzo (ghi) perylene
- Benzo (k) fluoranthene
- Indeno (123-cd) pyrene
- Fluoranthene
- Copper
- Iron
- Lead
- Mercury
- Nickel
- Zinc
- Trichloromethane

Part B screening-

There were no releases of substances which constituted a significant load.

Test 1 confluence Morlais/Loughor- The following substances have failed test 1:

- Benzo (b) fluoranthene
- Benzo (ghi) perylene
- Benzo (k) fluoranthene
- Fluoranthene
- Indeno (123-cd) pyrene
- Nickel

Test 2 confluence Morlais/Loughor - The following substances have failed test 2:

- Anthracene
- Benzo (a) pyrene
- Benzo (b) fluoranthene
- Benzo (ghi) perylene
- Benzo (k) fluoranthene
- Indeno (123-cd) pyrene
- Fluoranthene
- Cobalt
- Iron
- Nickel
- Trichloromethane
- Zinc
- Xylenes

Test 3 confluence Morlais/Loughor - The following substances have failed test 3:

- Anthracene
- Benzo (a) pyrene
- Benzo (b) fluoranthene
- Benzo (ghi) perylene
- Benzo (k) fluoranthene
- Indeno (123-cd) pyrene
- Fluoranthene
- Cobalt

- Iron
- Nickel
- Trichloromethane
- Dichloromethane
- Zinc

Test 4 confluence Morlais/Loughor - The following substances have failed test 4:

- Benzo (a)pyrene
- Benzo (b) fluoranthene
- Benzo (ghi) perylene
- Benzo (k) fluoranthene
- Indeno (123-cd) pyrene
- Fluoranthene
- Nickel
- Zinc
- Trichloromethane

Part B screening-

There were no releases of substances which constituted a significant load.

3 ECOLOGICAL CONSIDERATIONS

In August 2020, following a train derailment, an estimated 250,000 to 400,000 litres of diesel was lost to the environment near Llangennech, Carmarthenshire. The fuel loss impacted the local ground, groundwater, surface watercourses and the wider Loughor Estuary, a highly sensitive saltmarsh and intertidal zone comprising river and estuarine environments that form part of the Burry Inlet and Loughor Estuary Site of Special Scientific Interest (SSSI) and the Carmarthen Bay and Estuaries Special Area of Conservation (SAC), Burry Inlet Special Protection Area and Ramsar.

Preliminary surveys of the key habitats, the reedbed and saltmarsh revealed isolated deposits of diesel within the habitat although no direct damage to plants was apparent. A detailed National Vegetation Classification (NVC) survey was completed in the late autumn (2020) and further surveys in 2021 planned to assess the impact on these key designated habitats.

In regard to the designated fish species, Allis shad, *Alosa alosa*, Twaite shad *Alosa fallax*, river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* and the Eurasian otter *Lutra lutra*, no fish mortalities reported at the Afon Morlais or the Loughor Estuary. Fisheries surveys are planned for 2021 to assess the potential impact on these and other key migratory species, European eel *Anguilla anguilla* and Atlantic salmon *Salmo salar*.

Preliminary works did suggest an impact on the estuary's bivalve community, with dead cockles washed up on the foreshore. Surveys are ongoing to assess the effect on the commercially important cockle beds. Analysis of the cockles for hydrocarbon revealed that levels were within the limits for human consumption.

Further survey of over-wintering birds and invertebrates are planned as part of the monitoring programme.

The train derailment site at Llangennech is located outside of the Burry Inlet and Loughor Estuary Site of Special Scientific Interest (SSSI) and the Carmarthen Bay and Estuaries Special Area of Conservation (SAC), Burry Inlet Special Protection Area and Ramsar. As the 'Interception Ditch' is connected to the Afon Morlais, which forms part of the designated nature conservation sites, the potential effect of the interceptor on ecology has been considered.

Four species of fish, Allis shad, *Alosa alosa*, Twaite shad *Alosa fallax*, river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* and the Eurasian otter *Lutra lutra* are designated under the SAC and could be affected by the design of the interceptor. In addition, the Annex II species Atlantic salmon *Salmo salar*, are also known to be present in the catchment.

The introduction of the interceptor is likely to function as a barrier to the fish species, however, the habitat within the Interceptor Drain does not feature in the requirement of the life stages of any species (see Table below) and therefore not considered to represent any significant habitat loss. Otters could select the Interceptor Ditch as habitat, potentially as a resting place, however this would unlikely be affected by the interceptor structure.

Species	Preferred habitat
Allis shad	Allis shad are an anadromous species, living at sea and adults migrate to freshwater in order to spawn. Shad spawn on clean rocky substrates and the eggs require clean well oxygenated water to survive. The fry remain in freshwater for only a matter of months before migrating to sea as juvenile fish.
Twaite shad	See above

River lamprey	Adult fish spawn in clean gravels and the juvenile fish, or ammocoetes, migrate and select soft silty beds with a good adjacent flow. Adults migrate downstream.
Sea lamprey	See above and as adults the fish migrate to sea before returning to spawn.
Atlantic salmon	Similar to shad, adult fish spawn in clean stony substrates in fast flowing rivers. Juveniles remain in situ for two to three years before migrating to sea as smolts.

Contaminant Source	Receptor	Pathway	Prior to control measures			Current control measures	Following control measures		
			Associated Hazard (Severity)	Likelihood of Occurrence	Potential Risk of Harm or Significant Impacts (RR)		S	L	RR
Works to address spilled diesel at the site of the train derailment. Includes sorbed / trapped LNAPL, mobile LNAPL, contaminated groundwater, contaminated sediment in drainage channels and surface waters	Controlled Waters (Surface Water) Surrounding water courses including drainage ditches, Afon Morlais and River Loughor	Direct discharge of product to interconnected drainage channels and surface watercourses	Pollution of Controlled Waters Severe	High Likelihood	Very high	Containment measures are in place including pipe dams, booms and absorbents to control product entering water courses, a surface water sampling and monitoring programme is being undertaken, ongoing remedial excavation works will reduce the source of contaminants of concern. Water is currently being diverted collected and disposed of to reduced incoming source to surface water receptors as described in the non-technical summary. Once remedial excavations are complete the longer term remedial strategy will be refined to address any remaining unacceptable risk from residual impacts at depth and from migration of any impacted groundwater.	Mild	Likely	Moderate/Low

Contaminant Source	Receptor	Pathway	Prior to control measures			Current control measures	Following control measures		
			Associated Hazard (Severity)	Likelihood of Occurrence	Potential Risk of Harm or Significant Impacts (RR)		S	L	RR
	Ecologically Sensitive Sites Ecologically sensitive, protected habitats down-gradient of the spill site (SSSI, SAC and Ramsar Site)	Migration of product via interconnected drainage channels and surface watercourses	Lasting damage to habitats and dependant populations (e.g., cockles) Severe	Low Likelihood	Moderate	Containment measures are in place including pipe dams, booms and absorbents to control product entering water courses, ecological surveys and monitoring programme is in place, ongoing remedial excavation works will reduce the source of contaminants of concern. Water is currently being diverted collected and disposed of to reduced incoming source to surface water receptors as described in the non-technical summary. Once remedial excavations are complete and the results of the current survey works completed the longer term remedial strategy will be refined to address any remaining unacceptable risk to ecological receptors.	Mild	Low Likelihood	Low

Contaminant Source	Receptor	Pathway	Prior to control measures			Current control measures	Following control measures		
			Associated Hazard (Severity)	Likelihood of Occurrence	Potential Risk of Harm or Significant Impacts (RR)		S	L	RR
	Controlled Waters (Groundwater) Underlying Secondary A aquifers associated with Superficial and Bedrock strata	Leaching / desorption of LNAPL, continued contamination of groundwater in the vicinity of the spill site	Pollution of Controlled Waters Medium	High Likelihood	High	A groundwater monitoring and sampling programme is in place, works have delineated groundwater impacts to be contained laterally by the northern and southern drainage ditches. Remedial excavation works are ongoing to remove grossly impacted shallow soils to reduce the impact to groundwater, following completion the longer term remedial strategy will be refined to treat any residual contaminants that pose further unacceptable risks to groundwater.	Medium	Likely	Moderate
	Buildings & Infrastructure MMTS Scheme infrastructure	Potential interaction with untreated mine water and the infrastructure of the MMTS Scheme	Affect the efficiency of mine water treatment within the MMTS and thereby affect the quality of discharge into the Afon Morlais. Mild	Likely	Moderate / Low	Investigation works are ongoing and will further quantify this risk as well as provided any further mitigation measures which could be implemented to further control any unacceptable interactions where practically possible.	Mild	Likely	Moderate/Low

Contaminant Source	Receptor	Pathway	Prior to control measures			Current control measures	Following control measures		
			Associated Hazard (Severity)	Likelihood of Occurrence	Potential Risk of Harm or Significant Impacts (RR)		S	L	RR
			Affect the slope stability, particularly the southern wall of the MMTS adjacent to the spill area Severe	Unlikely	Moderate / Low	Investigation works are ongoing and will further quantify this risk as well as providing mitigation measures to ensure stability is maintained.	Severe	Unlikely	Moderate/Low
	Human Health MMTS workers and site staff working collecting water samples	Dermal contact	Contact dermatitis Mild	Low Likelihood	Low	The coal authority is aware of the incident and containment measure/ongoing investigation and remedial works being undertaken and have been advised of the potential precautions to be undertaken during sampling (i.e ppe etc)	Minor	Unlikely	Very Low
		Diesel volatilisation and subsequent inhalation	Headaches, irritation to the lungs and throat Mild	Low Likelihood	Low	Diesel has a low volatility; air can be monitored with a PID during any works/sampling and additional measured implemented as necessary (i.e RPE)	Minor	Unlikely	Very Low

Contaminant Source	Receptor	Pathway	Prior to control measures			Current control measures	Following control measures		
			Associated Hazard (Severity)	Likelihood of Occurrence	Potential Risk of Harm or Significant Impacts (RR)		S	L	RR
Works to address spilled diesel at the site of the train derailment. Includes sorbed / trapped LNAPL, mobile LNAPL, contaminated groundwater, contaminated sediment in drainage channels and surface waters	Human Health-Accidents	Accidents resulted from the investigation, monitoring, sampling and remedial works.	Severe	Likely	High	The site is being managed in line with Adler and Allans management systems. Details are contained within Adler and Allans Emergency Plan and Construction Phase Management Plan. Specific RA and MS are available on a task specific basis and are available on request.	Mild	Low Likelihood	Low
	Surface water/ecological receptors/groundwater	Accidental release of chemicals used onsite (this includes minor amounts of fuels, bentonite, cement, calibration and preservation fluids used for sampling.	Mild	Low Likelihood	Low	Management of these substances is conducted under Adler and Allans health and safety management system, storage. Details are contained within Adler and Allans Emergency Plan and Construction Phase Management Plan.	Mild	Unlikely	Very Low

Contaminant Source	Receptor	Pathway	Prior to control measures			Current control measures	Following control measures		
			Associated Hazard (Severity)	Likelihood of Occurrence	Potential Risk of Harm or Significant Impacts (RR)		S	L	RR
Waste streams resulting from site works (general waste and excavated soils), litter and any pests that may result.	Human health, ecological, surface and groundwater receptors.	Inhalation, ingestion, contact and leaching of wastes to soils and/or groundwaters and migration to surface waters.	Medium	Likely	Moderate	Solid waste is stored in a designated area inside a sealed waste bund, sorted and loading onto a licensed waste carrier for onward disposal. NRW have attended site to inspect the waste storage areas and have discussed the NWFD waste exemption for the temporary storage of this waste and Alder and Allans registration as a hazardous waste producer and have confirmed they are satisfied with the measures onsite. Site will be kept tidy and free of litter to prevent pests. Excavation/surface water is being managed by Vac tanker at present, the only waters flowing off site is the natural upwellings which already existed prior to the index event. The water is being filtered also by silt curtains and a pipe dam system which has been installed as part of the emergency containment phase of the works and is still in place until as discharge permit has been accepted.	Mild	Low likelihood	Low

Contaminant Source	Receptor	Pathway	Prior to control measures			Current control measures	Following control measures		
			Associated Hazard (Severity)	Likelihood of Occurrence	Potential Risk of Harm or Significant Impacts (RR)		S	L	RR
Noise generated from transportation of soils off-site for disposal	Human Health	Nuisance	Minor	Likely	Low	Haulage to and from site is being completed in daytime hours of 06.00 – 19.00. this is where noise would be created from transport which only passes the farm at the entrance to the site. Farmer is aware and happy with the arrangement.	Minor	Unlikely	Very Low
Dust	No Risk					No dust is being generated; the site is remote from residential housing/public areas.	No Risk		
Visible emissions	No Risk					There are no sources of visible emissions onsite.	No Risk		
Bioaerosols	No Risk					There are no sources of bioaerosols onsite.	No Risk		

Table 1-Pipe Dam 3 Discharge

[illegible]

Table 1-Pipe Dam 3 Discharge

1,2-Dichlorobenzene	20	200	-	up1	<0.05	-	-	-	3	3	3	3	3	3	3	3	3	0.05	0.05	0.05	0.05	3	0.05	0.05	3	-	3	0.05	3	0.05	1.974	3	0.05	
1,2-Dichloro-3-chlorobenzene	-	-	-	up1	<0.05	-	-	-	22	2	2	2	2	2	2	2	2	0.05	0.05	0.05	0.05	2	0.05	0.05	2	-	2	0.05	2	0.05	2.191	20	0.05	
1,2,4-Trichlorobenzene	-	-	-	up1	<0.05	-	-	-	3	3	3	3	3	3	3	3	3	0.05	0.05	0.05	0.05	3	0.05	0.05	3	-	3	0.05	3	0.05	1.974	3	0.05	
Hexachlorocyclopentadiene	-	0.6	0.005	up1	<0.05	-	-	-	3	3	3	3	3	3	3	3	3	0.05	0.05	0.05	0.05	3	0.05	0.05	3	-	3	0.05	3	0.05	1.974	3	0.05	
Naphthalene	2	120	-	up1	<0.05	-	-	-	2	2	2	2	2	2	2	2	2	0.05	0.05	0.05	0.45	2	0.05	0.05	2	-	2	0.05	2	0.05	1.539	2	0.05	
1,2,3-Trichlorobenzene	0.4	-	-	up1	<0.05	-	-	-	3	3	3	3	3	3	3	3	3	0.05	0.05	0.05	0.05	3	0.05	0.05	3	-	3	0.05	3	0.05	1.974	3	0.05	
Diethyl Ether*	-	-	-	up1	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	0.05	0.05	0.05	0.05	-	0.05	0.05	-	-	-	0.05	-	0.05	0.050	0.05	0.05	
Methyl Isobutyl	-	-	-	up1	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	0.05	0.05	0.05	0.05	-	0.05	0.05	-	-	-	0.05	-	0.05	0.050	0.05	0.05	
1-Chlorobenzene	-	-	-	up1	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	0.05	0.05	0.05	0.05	-	0.05	0.05	-	-	-	0.05	-	0.05	0.050	0.05	0.05	
Acrylonitrile*	-	-	-	up1	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	0.05	0.05	0.05	0.05	-	0.05	0.05	-	-	-	0.05	-	0.05	0.050	0.05	0.05	
Heptane	-	-	-	up1	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	0.05	0.05	0.05	0.05	-	0.05	0.05	-	-	-	0.05	-	0.05	0.050	0.05	0.05	
Propylenediol*	-	-	-	up1	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	0.05	0.05	0.05	0.05	-	0.05	0.05	-	-	-	0.05	-	0.05	0.050	0.05	0.05	
Methyl Acrylate*	-	-	-	up1	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	0.05	0.05	0.05	0.05	-	0.05	0.05	-	-	-	0.05	-	0.05	0.050	0.05	0.05	
Methoxyacetone*	-	-	-	up1	<0.1	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.1	0.1	0.1	-	0.1	0.1	-	-	-	0.1	-	0.1	0.100	0.1	0.1	
1,2-Dichloroethane (1,2-DC)	-	-	-	up1	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	0.05	0.05	0.05	0.05	-	0.05	0.05	-	-	-	0.05	-	0.05	0.050	0.05	0.05	
1-Chlorobutane*	-	-	-	up1	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	0.05	0.05	0.05	0.05	-	0.05	0.05	-	-	-	0.05	-	0.05	0.050	0.05	0.05	
Methyl Methacrylate*	-	-	-	up1	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	0.05	0.05	0.05	0.05	-	0.05	0.05	-	-	-	0.05	-	0.05	0.050	0.05	0.05	
Ethyl Methacrylate*	-	-	-	up1	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	0.05	0.05	0.05	0.05	-	0.05	0.05	-	-	-	0.05	-	0.05	0.050	0.05	0.05	
Trans-1,4-Dichloro-2-butene*	-	-	-	up1	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	0.05	0.05	0.05	0.05	-	0.05	0.05	-	-	-	0.05	-	0.05	0.050	0.05	0.05	
Hexachlorocyclopentadiene	-	-	-	up1	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	0.05	0.05	0.05	0.05	-	0.05	0.05	-	-	-	0.05	-	0.05	0.050	0.05	0.05	
Nitrobenzene	-	-	-	up1	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	0.5	0.5	0.5	0.5	-	0.5	0.5	-	-	-	0.5	-	0.5	0.500	0.5	0.5	
Methyl Tertiary Butyl Ether*	15	15	-	up1	<0.1	5	5	5	0.1	0.1	0.1	-	0.1	0.1	0.1	-	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.005	5	0.1	
Decane*	5	50	-	up1	<0.5	5	5	5	0.5	0.5	0.5	-	0.5	0.5	0.5	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.005	5	0.5	
Toluene*	74	370	-	up1	<5	5	5	5	5	5	5	-	5	5	5	-	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5.000	5	5	
Ethylbenzene*	-	-	-	up1	<1	5	5	5	1	1	1	-	1	1	1	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.071	5	1	
n-Butane*	30	-	-	up1	<2	5	7	5	2	2	2	-	2	2	2	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.504	7	2	
i-Butane*	30	-	-	up1	<1	13	16	5	11	1	1	-	1	1	1	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3.238	14	1	
EPRI CHG Interpretation																																		
	-	-	-	None	No interpretation possible	No interpretation possible	No interpretation possible	Observed Phase Accurate	No interpretation possible	Observed phase accurate	Observed maximum & Observed phase accurate	Observed phase composite	Observed Phase Accurate	No interpretation possible	No interpretation possible	Trace of possible degraded steel	No interpretation possible	Possible trace of degraded steel	Observed phase accurate	Observed phase accurate	No interpretation possible	Observed phase accurate	Degraded bio-dead	Possible Degraded Observed, Possible Quantify Residual & Possible Trace Laboratory CI	No interpretation possible	Degraded bio-dead	-	No interpretation possible	No interpretation possible	No interpretation possible	No interpretation possible	-	-	-
TTH CHG																																		
Aliphatics																																		
HCHC8	-	-	-	up1	<10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10.000	10	10	
HCHC9	-	-	-	up1	<10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10.442	10	10	
HCHC10	-	-	-	up1	<10	10	10	10	13	10	13	16	23	23	10	10	10	15	14	10	45	10	26	329	16	10	10	10	10	10	27.269	329	10	
HCHC12	-	-	-	up1	<5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	265	764	5	260	-	5	5	5	55.536	764	5	
HCHC16	-	-	-	up1	<10	10	10	10	10	10	10	120	10	10	60	10	40	10	10	10	10	10	10	10	10	10	10	10	10	10	100.760	2260	10	
HCHC21	-	-	-	up1	<10	10	10	10	10	10	10	10	260	10	10	10	100	10	10	10	10	10	10	500	2770	10	760	-	10	10	10	165.000	2770	10
HCHC25	-	-	-	up1	<10	10	10	10	10	10	10	10	330	10	10	10	90	10	10	10	10	10	10	420	1670	10	410	-	10	10	10	128.077	1670	10
Total Aliphatics C8-25	-	-	-	up1	<10	10	10	10	13	10	13	16	800	23	10	10	340	15	154	10	40	10	26	2060	7020	10	2140	-	10	10	10	516.846	7020	10
Aromatics																																		
HCHC27	-	-	-	up1	<10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10.000	10	10	
HECC-EC8	-	-	-	up1	<10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10.000	10	10	
HECC-EC10	-	-	-	up1	<10	13	21	10	11	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	11.636	26	10	
HECC-EC12	-	-	-	up1	<5	25	5	5	62	5	87	22	44	5	5	5	5	5	5	5	5	5	216	350	335	5	145	-	5	5	5	63.506	350	5
HECC-EC16	-	-	-	up1	<10	10	10	10	10	10	10	10	160	10	10	140	10	10	10	10	10	10	10	10	10	10	10	10	10	10	100.365	860	10	
HECC-EC21	-	-	-	up1	<10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	76.536	1170	10	
HECC-EC25	-	-	-	up1	<10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	62.862	1310	10	
Total Aromatics C8-25	-	-	-	up1	<10	30	21	10	73	10	117	162	344	140	10	10	10	10	172	328	10	448	829	3716	10	865	-	10	10	10	205.138	3716	10	
Total aliphatics and aromatics (C8-25)	-	-	-	up1	<10	57	30	10	86	10	130	168	1307	163	10	10	340	15	154	101	373	10	472	2905	11280	10	3005	-	10	10	10	768.885	11280	10
Fluorene	5	15	-	up1	<0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	-	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	0.300	0.3	0.3	
Sulfolane as SO4	-	-	-	up1	<0.5	100.0	107.7	116.8</																										

Table 2- Pipe Dam 4 Discharge

[illegible]

Table 2- Pine Dam 4 Discharge

[illegible]

- Not tested for/Not relevant

Table 3 SW4 (Downstream)

[illegible]

Table 3 SW4 (Downstream)

[illegible]

- Not tested for/Not relevant

Table 4 SW5 (Upstream)

Sample Location Sample Time Flow Observations			SW1		SW2		SW3		SW4		SW5		SW6		SW7		SW8		SW9		SW10		SW11		SW12		SW13		SW14		SW15		SW16		SW17		SW18		SW19		SW20		SW21		SW22		SW23		SW24		SW25		SW26		SW27		SW28		SW29		SW30		SW31		SW32		SW33		SW34		SW35		SW36		SW37		SW38		SW39		SW40		SW41		SW42		SW43		SW44		SW45		SW46		SW47		SW48		SW49		SW50		SW51		SW52		SW53		SW54		SW55		SW56		SW57		SW58		SW59		SW60		SW61		SW62		SW63		SW64		SW65		SW66		SW67		SW68		SW69		SW70		SW71		SW72		SW73		SW74		SW75		SW76		SW77		SW78		SW79		SW80		SW81		SW82		SW83		SW84		SW85		SW86		SW87		SW88		SW89		SW90		SW91		SW92		SW93		SW94		SW95		SW96		SW97		SW98		SW99		SW100		SW101		SW102		SW103		SW104		SW105		SW106		SW107		SW108		SW109		SW110		SW111		SW112		SW113		SW114		SW115		SW116		SW117		SW118		SW119		SW120		SW121		SW122		SW123		SW124		SW125		SW126		SW127		SW128		SW129		SW130		SW131		SW132		SW133		SW134		SW135		SW136		SW137		SW138		SW139		SW140		SW141		SW142		SW143		SW144		SW145		SW146		SW147		SW148		SW149		SW150		SW151		SW152		SW153		SW154		SW155		SW156		SW157		SW158		SW159		SW160		SW161		SW162		SW163		SW164		SW165		SW166		SW167		SW168		SW169		SW170		SW171		SW172		SW173		SW174		SW175		SW176		SW177		SW178		SW179		SW180		SW181		SW182		SW183		SW184		SW185		SW186		SW187		SW188		SW189		SW190		SW191		SW192		SW193		SW194		SW195		SW196		SW197		SW198		SW199		SW200		SW201		SW202		SW203		SW204		SW205		SW206		SW207		SW208		SW209		SW210		SW211		SW212		SW213		SW214		SW215		SW216		SW217		SW218		SW219		SW220		SW221		SW222		SW223		SW224		SW225		SW226		SW227		SW228		SW229		SW230		SW231		SW232		SW233		SW234		SW235		SW236		SW237		SW238		SW239		SW240		SW241		SW242		SW243		SW244		SW245		SW246		SW247		SW248		SW249		SW250		SW251		SW252		SW253		SW254		SW255		SW256		SW257		SW258		SW259		SW260		SW261		SW262		SW263		SW264		SW265		SW266		SW267		SW268		SW269		SW270		SW271		SW272		SW273		SW274		SW275		SW276		SW277		SW278		SW279		SW280		SW281		SW282		SW283		SW284		SW285		SW286		SW287		SW288		SW289		SW290		SW291		SW292		SW293		SW294		SW295		SW296		SW297		SW298		SW299		SW300		SW301		SW302		SW303		SW304		SW305		SW306		SW307		SW308		SW309		SW310		SW311		SW312		SW313		SW314		SW315		SW316		SW317		SW318		SW319		SW320		SW321		SW322		SW323		SW324		SW325		SW326		SW327		SW328		SW329		SW330		SW331		SW332		SW333		SW334		SW335		SW336		SW337		SW338		SW339		SW340		SW341		SW342		SW343		SW344		SW345		SW346		SW347		SW348	
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Table 4 SWS (Upstream)

1,2,4-Trinitrofluorene	-	-	-	up1	<0.05	-	3	3	3	3	3	3	3	3	3	3	0.05	-	-	0.05	0.05	0.05	3	0.05	0.05	3	0.05	3	0.05	3	0.05	1,846	3	0.05
iso-Butylbenzene	-	-	-	up1	<0.05	-	3	3	3	3	3	3	3	3	3	3	0.05	-	-	0.05	0.05	0.05	3	0.05	0.05	3	0.05	3	0.05	3	0.05	1,846	3	0.05
4-Propoxybenzene	-	-	-	up1	<0.05	-	3	3	3	3	3	3	3	3	3	3	0.05	-	-	0.05	0.05	0.05	3	0.05	0.05	3	0.05	3	0.05	3	0.05	1,846	3	0.05
1,3-Dichlorobenzene	20	200	-	up1	<0.05	-	3	3	3	3	3	3	3	3	3	3	0.05	-	-	0.05	0.05	0.05	3	0.05	0.05	3	0.05	3	0.05	3	0.05	1,846	3	0.05
1,4-Dichlorobenzene	20	200	-	up1	<0.05	-	3	3	3	3	3	3	3	3	3	3	0.05	-	-	0.05	0.05	0.05	3	0.05	0.05	3	0.05	3	0.05	3	0.05	1,846	3	0.05
1,4-Dibromobenzene	-	-	-	up1	<0.05	-	3	3	3	3	3	3	3	3	3	3	0.05	-	-	0.05	0.05	0.05	3	0.05	0.05	3	0.05	3	0.05	3	0.05	1,846	3	0.05
1,2-Dichlorobenzene	20	200	-	up1	<0.05	-	3	3	3	3	3	3	3	3	3	3	0.05	-	-	0.05	0.05	0.05	3	0.05	0.05	3	0.05	3	0.05	3	0.05	1,846	3	0.05
1,2-Dibromo-3-chloropropane	-	-	-	up1	<0.05	-	2	2	2	2	2	2	2	2	2	2	0.05	-	-	0.05	0.05	0.05	2	0.05	0.05	2	0.05	2	0.05	2	0.05	1,237	2	0.05
1,3-A-Trinitrobenzene	-	-	-	up1	<0.05	-	3	3	3	3	3	3	3	3	3	3	0.05	-	-	0.05	0.05	0.05	3	0.05	0.05	3	0.05	3	0.05	3	0.05	1,846	3	0.05
Heptafluorobenzene	-	0.6	0.005	up1	<0.05	-	3	3	3	3	3	3	3	3	3	3	0.05	-	-	0.05	0.05	0.05	3	0.05	0.05	3	0.05	3	0.05	3	0.05	1,846	3	0.05
Naphthalene	2	130	-	up1	<0.05	-	2	2	2	2	2	2	2	2	2	2	0.05	-	-	0.05	0.05	0.05	2	0.05	0.05	2	0.05	2	0.05	2	0.05	1,237	2	0.05
1,2,3-Trinitrobenzene	0.4	-	-	up1	<0.05	-	3	3	3	3	3	3	3	3	3	3	0.05	-	-	0.05	0.05	0.05	3	0.05	0.05	3	0.05	3	0.05	3	0.05	1,846	3	0.05
Dechlor Ethar	-	-	-	up1	<0.05	-	-	-	-	-	-	-	-	-	-	-	0.05	-	-	0.05	0.05	0.05	-	0.05	0.05	-	0.05	-	0.05	-	0.05	0.05	0.05	0.05
Methyl Isobutyl	-	-	-	up1	<0.05	-	-	-	-	-	-	-	-	-	-	-	0.05	-	-	0.05	0.05	0.05	-	0.05	0.05	-	0.05	-	0.05	-	0.05	0.05	0.05	0.05
5-Chloropropene	-	-	-	up1	<0.05	-	-	-	-	-	-	-	-	-	-	-	0.05	-	-	0.05	0.05	0.05	-	0.05	0.05	-	0.05	-	0.05	-	0.05	0.05	0.05	0.05
Hexachloride	-	-	-	up1	<0.05	-	-	-	-	-	-	-	-	-	-	-	0.05	-	-	0.05	0.05	0.05	-	0.05	0.05	-	0.05	-	0.05	-	0.05	0.05	0.05	0.05
Hexane	-	-	-	up1	<0.05	-	-	-	-	-	-	-	-	-	-	-	0.05	-	-	0.05	0.05	0.05	-	0.05	0.05	-	0.05	-	0.05	-	0.05	0.05	0.05	0.05
Propylene	-	-	-	up1	<0.05	-	-	-	-	-	-	-	-	-	-	-	0.05	-	-	0.05	0.05	0.05	-	0.05	0.05	-	0.05	-	0.05	-	0.05	0.05	0.05	0.05
Methyl Acrylate	-	-	-	up1	<0.05	-	-	-	-	-	-	-	-	-	-	-	0.05	-	-	0.05	0.05	0.05	-	0.05	0.05	-	0.05	-	0.05	-	0.05	0.05	0.05	0.05
Methoxybenzene	-	-	-	up1	<0.1	-	-	-	-	-	-	-	-	-	-	-	0.1	-	-	0.1	0.1	0.1	-	0.1	0.1	-	0.1	-	0.1	-	0.1	0.1	0.1	0.1
Tetrahydrofuran (THF)	-	-	-	up1	<0.05	-	-	-	-	-	-	-	-	-	-	-	0.05	-	-	0.05	0.05	0.05	-	0.05	0.05	-	0.05	-	0.05	-	0.05	0.05	0.05	0.05
1-Chlorobutane	-	-	-	up1	<0.05	-	-	-	-	-	-	-	-	-	-	-	0.05	-	-	0.05	0.05	0.05	-	0.05	0.05	-	0.05	-	0.05	-	0.05	0.05	0.05	0.05
Methyl Methacrylate	-	-	-	up1	<0.05	-	-	-	-	-	-	-	-	-	-	-	0.05	-	-	0.05	0.05	0.05	-	0.05	0.05	-	0.05	-	0.05	-	0.05	0.05	0.05	0.05
Ethyl Methacrylate	-	-	-	up1	<0.05	-	-	-	-	-	-	-	-	-	-	-	0.05	-	-	0.05	0.05	0.05	-	0.05	0.05	-	0.05	-	0.05	-	0.05	0.05	0.05	0.05
Trans-1,4-Dichloro-2-butene	-	-	-	up1	<0.05	-	-	-	-	-	-	-	-	-	-	-	0.05	-	-	0.05	0.05	0.05	-	0.05	0.05	-	0.05	-	0.05	-	0.05	0.05	0.05	0.05
Heptafluorobenzene	-	-	-	up1	<0.05	-	-	-	-	-	-	-	-	-	-	-	0.05	-	-	0.05	0.05	0.05	-	0.05	0.05	-	0.05	-	0.05	-	0.05	0.05	0.05	0.05
Hexachloride	-	-	-	up1	<0.1	-	-	-	-	-	-	-	-	-	-	-	0.1	-	-	0.1	0.1	0.1	-	0.1	0.1	-	0.1	-	0.1	-	0.1	0.1	0.1	0.1
Methyl Tertiary Butyl Ether	15	15	-	up1	<0.1	5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-	0.1	-	5	5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Benzene	8	50	-	up1	<0.5	5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	-	0.5	-	5	5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Toluene	74	370	-	up1	<5	5	5	5	5	5	5	5	5	5	5	5	-	5	-	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
Ethylbenzene	-	-	-	up1	<1	5	1	1	1	1	1	1	1	1	1	1	-	1	-	5	5	1	1	1	1	1	1	1	1	1	1	1	1	
isop-Xylene	30	-	-	up1	<2	5	2	2	2	2	2	2	2	2	2	2	-	2	-	5	5	2	2	2	2	2	2	2	2	2	2	2	2	
o-Xylene	30	-	-	up1	<1	5	1	1	1	1	1	1	1	1	1	1	-	1	-	5	5	1	1	1	1	1	1	1	1	1	1	1	1	
UP1/CHG Interpretation	-	-	-	None		No Interpretation Possible	No Interpretation Possible	No Interpretation possible	No Interpretation possible	No Interpretation possible	No Interpretation possible	No Interpretation possible	No Interpretation possible	No Interpretation possible	No Interpretation possible	No Interpretation possible	No Interpretation Possible	No Interpretation possible	No Interpretation possible	No Interpretation possible	No Interpretation possible	No Interpretation possible	No Interpretation possible	No Interpretation possible	No Interpretation possible	No Interpretation possible	No Interpretation possible	No Interpretation possible	No Interpretation possible	No Interpretation possible	No Interpretation possible	-	-	-
THERMOS																																		
Aliphatics																																		
HC2-C8	-	-	-	up1	<10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
HC8-C8	-	-	-	up1	<10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
HC8-C10	-	-	-	up1	<10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
HC12-C12	-	-	-	up1	<5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
HC12-C16	-	-	-	up1	<10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
HC16-C21	-	-	-	up1	<10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
HC17-C18	-	-	-	up1	<10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Total aliphatics C5-35	-	-	-	up1	<10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Aromatics																																		
HC2-C11	-	-	-	up1	<10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
HC7-C18	-	-	-	up1	<10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
HC8-C19	-	-	-	up1	<10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
HC10-EC12	-	-	-	up1	<5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
HC13-EC16	-	-	-	up1	<10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10													

Table 5 SW3 (Confluence Between Afon Morlais/Loughor)

[illegible]