Appendix 15.1
Water Quality Calculations

M74 Junction 5, Raith
Water Quality Calculations

Outfall to Clyde - Combined discharge from all road sections associated with the option D proposals for the Raith Junction

As various outfall options were initially considered, contaminant concentration and risk of spillage were calculated for individual
road sections. When a single outfall to the river Clyde was determined to provide the optimum solution, figures from the road sections
were combined to produce an indication of the impact of runoff from the amended junction on the watercourse.

Risk of Spillage:

$P_{acc\ total}$ =	0.01088	(Sum of probability of spillage for individual road sections. *Method D,*
		Annex I, Part 10, Section 3, Volume 11, DMRB - HA 216/06)
Risk of Pollution P_{pol} =	0.004896	(Probability of spillage with risk reduction factor applied: 0.45,
		assuming RE2 - high quality watercourse, < 20min
Annual probability of serious pollution incident P_{INC} =	0.49 %	emergency response. *Table D2, Annex I, HA 216/06*)

Concentration of contaminants:

Total Runoff Volume (V)	793.665 m³/day	(Sum of runoff volume for individual road sections)
Q_{95}	668736 m³/day	(Blairston GS, *Hydrometric Register and Statistics 1996 - 2000, CEH Wallingford*)
Total Dissolved Copper 5 day Build-up Rate (M_{cu})	0.087376 kg	(Sum of copper build-up for individual road sections)
U/S Dissolved Copper (C_b)	0.00162 mg/l	(For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)

$$C_r = [(C_b * Q_{95}) + (1000 * M)] / (Q_{95} + V)$$ (*Method B, Annex I, HA 216/06*)

Dissolved Copper Concentration, $C_{r\ cu}$	0.001749 mg/l	
	= 1.75 µg/L	
Total Zinc 5 day Build-up	0.380629 kg	(Sum of zinc build-up for individual road sections)
U/S Zinc	0.01045 mg/l	(For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)
$C_{r\ Zn}$	0.011006 mg/l	
	= 11.01 µg/L	

M74 Junction 5, Raith
Water Quality Calculations

Outfall 500 into Clyde - Raith Junction

Risk of Spillage:			
NB Road Length > 100m from slip inc M003	95	m	
NB Road Length < 100m from slip inc M003	100	m	
NB RL < 100m from slip ex M003	100	m	
NB RL > 100m from slip ex M003	205	m	
SB Road Length > 100m from slip inc M006	10	m	
SB Road Length < 100m from slip inc M006	100	m	
SB RL < 100m from slip ex M006	100	m	
SB RL > 100m from slip ex M006	290	m	
Serious spillage rate > 100m from slip	0.31		(Figures assume an all purpose urban road.
Serious spillage rate < 100m from slip	0.36		*Table D1, Annex I, HA 216/06*)
AADT (NB inc. M003)	42179		
AADT (NB ex. M003)	28361		
AADT (SB inc. M006)	50480		
AADT (SB ex. M006)	25471		
HGV traffic (NB inc M003)	5.5	%	
HGV traffic (SB inc M006)	7.5		
HGV traffic (all others)	5	%	
Risk Reduction Factor	0.45		(Assuming RE2 - high quality - watercourse classification and < 20min emergency response. *Table D2, Annex I, HA 216/06*)

$$P_{acc} = RL * SS * (AADT * 365 / 10^9) * (HGV\% / 100)$$ (*Method D, Annex I, HA 216/06*)

Risk of Spillage NB $P_{acc > 100m \ from \ slip \ inc \ M003}$ =	0.00002494	
NB $P_{acc < 100m \ from \ slip \ inc. \ M003}$ =	0.00003048	
NB $P_{acc < 100m \ from \ slip \ ex. \ M003}$ =	0.00001863	
NB $P_{acc > 100m \ from \ slip \ ex. \ M003}$ =	0.00003289	
Risk of Spillage SB $P_{acc > 100m \ from \ slip \ inc \ M006}$ =	0.00000428	
SB $P_{acc < 100m \ from \ slip \ inc. \ M006}$ =	0.00004975	
SB $P_{acc < 100m \ from \ slip \ ex. \ M006}$ =	0.00001673	
SB $P_{acc > 100m \ from \ slip \ ex. \ M006}$ =	0.00004179	
$P_{acc \ total}$ =	0.00021950	
Risk of Pollution P_{pol} =	0.0001	
Probability	0.01	%

Water Quality:			
Copper Concentration			
Total Road Length (>30000)	305		
Total Road Length (<30000)	695	m	
Road Width	11	m	
Total Impervious Area (>30000)	3355	m²	
Total Impervious Area (<30000)	7645	m²	
Runoff Coefficient	0.75		(see justification *Environmental Statement Chapter 15*)
Rainfall Depth	12	mm/day	(Flood Estimation Handbook CD Rom, *Institute of*
Runoff Volume	99	m³/day	*Hydrology, 1999*)
Q_{95}	668736	m³/day	(Blairston Gauging Station)
Dissolved Copper Build-up Rate (>30000)	1.2	kg/ha/a	(*Table B1, Annex I, HA 216/06*)
Dissolved Copper Build-up Rate (<30000)	0.4	kg/ha/a	
Dissolved Copper 5 day Build-up Rate (>3..)	0.005515068	kg	
Dissolved Copper 5 day Build-up Rate (<3..)	0.004189041	kg	
Total dissolved copper 5 day build-up	0.00970411	kg	
U/S Dissolved Copper	0.00162	mg/l	(For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)

$$C_r = [(C_b * Q_{95}) + (1000 * M_{cu})] / (Q_{95} + V)$$ (*Method B, Annex I, HA 216/06*)

Dissolved Copper Concentration, $C_{r \ cu}$	0.001634269	mg/l
=	1.634269184	µg/L

Zinc Concentration		
Total Zinc Build-up Rate (>30000)	5	kg/ha/a	(*Table B1, Annex I, HA 216/06*)
Total Zinc Build-up Rate (<30000)	2	kg/ha/a	
Total Zinc 5 day Build-up Rate (>3…)	0.022979452	kg	
Total Zinc 5 day Build-up Rate (<3…)	0.020945205	kg	
Total total zinc 5 day build-up rate	0.043924658	kg	
U/S Total Zinc	0.01045	mg/l	(For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)
$C_{r \ Zn}$	0.010514127	mg/l	
	10.51412659	µg/L	

M74 Junction 5, Raith
Water Quality Calculations

Outfall 580 into Clyde - Raith Junction

Risk of Spillage:

Road Length > 100m away from slip rd	200 m	
Road Length < 100m away from slip rd	0 m	
Serious spillage rate > 100m from slip	0.31	(Figures assume an all purpose urban road.
Serious spillage rate < 100m from slip	0.36	*Table D1, Annex I, HA 216/06*)
AADT	53832	
HGV traffic	5 %	
Risk Reduction Factor	0.45	(Assuming RE2 - high quality - watercourse classification and < 20min emergency response. *Table D2, Annex I, HA 216/06*)

$$P_{acc} = RL * SS * (AADT * 365 / 10^9) * (HGV\% / 100)$$ (*Method D, Annex I, HA 216/06*)

Risk of Spillage $P_{acc\ road}$ =	0.0001	
$P_{acc\ <100m\ from\ slip}$ =	0.0000	
$P_{acc\ total}$ =	0.0001	
Risk of Pollution P_{pol} =	0.0000	
Return Period 1:	0.0027 %	

Water Quality:

Copper Concentration

Total Road Length	200 m	
Road Width	22 m	
Total Impervious Area	4400 m^2	
Runoff Coefficient	0.75	(see justification *Environmental Statement Chapter 15*)
Rainfall Depth	12 mm/day	(Flood Estimation Handbook CD Rom, *Institute of Hydrology, 1999*)
Runoff Volume	39.6 m^v/day	
Q_{95}	668736 m^3/day	(Blairston Gauging Station)
Dissolved Copper Build-up Rate	1.2 kg/ha/a	(*Table B1, Annex I, HA 216/06*)
Dissolved Copper 5 day Build-up Rate	0.00723 kg	
U/S Dissolved Copper	0.00162 mg/l	(For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)

$$C_r = [(C_b * Q_{95}) + (1000 * M_{cu})] / (Q_{95} + V)$$ (*Method B, Annex I, HA 216/06*)

Dissolved Copper Concentration, $C_{r\ cu}$	0.00163 mg/l	
=	1.63072 µg/L	

Zinc Concentration

Total Zinc Build-up Rate	5 kg/ha/a	(*Table B1, Annex I, HA 216/06*)
Total Zinc 5 day Build-up Rate	0.03014 kg	
U/S Total Zinc	0.01045 mg/l	(For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)
$C_{r\ Zn}$	0.01049 mg/l	
	10.4944 µg/L	

M74 Junction 5, Raith
Water Quality Calculations

Outfall 860 into Clyde - Raith Junction

Risk of Spillage:

NB Road Length > 100m from slip ex slip	455	m
NB Road Length < 100m from slip ex slip	100	m
NB RL < 100m from slip inc. slip	100	m
NB RL > 100m from slip inc.slip	395	
SB Road Length > 100m from slip ex slip	510	
SB Road Length < 100m from slip ex slip	100	
SB RL < 100m from slip inc slip	100	
SB RL > 100m from slip inc. slip	340	m
Serious spillage rate > 100m from slip	0.31	(Figures assume an all purpose urban road.
Serious spillage rate < 100m from slip	0.36	*Table D1, Annex I, HA 216/06*)
AADT (NB ex slip)	28361	
AADT (NB inc. slip)	49137	
AADT (SB ex. slip)	25471	
AADT (SB inc. slip)	49884	
HGV traffic (NB inc. Slip)	8	%
HGV traffic (SB inc. Slip)	7	%
HGV traffic others	5	%
Risk Reduction Factor	0.45	(Assuming RE2 - high quality - watercourse classification and < 20min emergency response. *Table D2, Annex I, HA 216/06*)

$$P_{acc} = RL * SS * (AADT * 365 / 10^9) * (HGV\% / 100)$$

(*Method D, Annex I, HA 216/06*)

Risk of Spillage NB $P_{acc > 100m \text{ from slip ex slip}}$ =	0.0001	
NB $P_{acc < 100m \text{ from slip ex slip}}$ =	0.0000	
NB $P_{acc < 100m \text{ from slip inc. slip}}$ =	0.0001	
NB $P_{acc > 100m \text{ from slip inc. slip}}$ =	0.0002	
Risk of Spillage SB $P_{acc > 100m \text{ from slip ex slip}}$ =	0.0001	
SB $P_{acc < 100m \text{ from slip ex slip}}$ =	0.0000	
SB $P_{acc < 100m \text{ from slip inc slip}}$ =	0.0000	
SB $P_{acc > 100m \text{ from slip inc slip}}$ =	0.0001	
$P_{acc \text{ total}}$ =	0.0006	
Risk of Pollution P_{pol} =	0.0003	
Return Period 1:	0.03	%

M74 Junction 5, Raith
Water Quality Calculations

Water Quality:

Copper Concentration

Total Road Length (<30000)	1165	m
Total Road Length (>30000)	935	m
Road Width	11	m
Total Impervious Area (<30000)	12815	m^2
Total Impervious Area (>30000)	10285	m^2
Runoff Coefficient	0.75	(see justification *Environmental Statement Chapter 15*)
Rainfall Depth	12	mm/day (Flood Estimation Handbook CD Rom, *Institute of*
Runoff Volume	207.9	m^3/day *Hydrology, 1999*)
Q_{95}	668736	m^3/day (Blairston Gauging Station)
Dissolved Copper Build-up Rate (<30000)	1.2	kg/ha/a (*Table B1, Annex I, HA 216/06*)
Dissolved Copper Build-up Rate (>30000)	0.4	
Dissolved Copper 5 day Build-up Rate (<3…)	0.02107	kg
Dissolved Copper 5 day Build-up Rate (>3…)	0.00564	kg
Total Dissolved Copper 5 day Build-up Rate	0.0267	kg
U/S Dissolved Copper	0.00162	mg/l (For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)

$$C_r = [(C_b * Q_{95}) + (1000 * M_{cu})] / (Q_{95} + V)$$

(*Method B, Annex I, HA 216/06*)

Dissolved Copper Concentration, $C_{r\,cu}$	0.00166	mg/l
=	1.65941	µg/L

Zinc Concentration

Total Zinc Build-up Rate (<30000)	5	kg/ha/a (*Table B1, Annex I, HA 216/06*)
Total Zinc Build-up Rate (>30000)	2	kg/ha/a
Total Zinc 5 day Build-up Rate (<3…)	0.08777	kg
Total Zinc 5 day Build-up Rate (>3…)	0.02818	kg
Total total zinc 5 day build-up rate	0.11595	kg
U/S Total Zinc	0.01045	mg/l (For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)
$C_{r\,Zn}$	0.01062	mg/l
	10.6201	µg/L

Outfall M003 into Clyde - Raith Junction

Risk of Spillage:			
Road Length < 100m away from side road	100	m	
Road Length < 100m away from slip rd	200	m	
Serious spillage rate < 100m from side road	1.81		(Figures assume an all purpose urban road.
Serious spillage rate < 100m from slip rd	0.36		*Table D1, Annex I, HA 216/06*)
AADT	13818		
HGV traffic	6	%	
Risk Reduction Factor	0.45		(Assuming RE2 - high quality - watercourse classification and < 20min emergency response. *Table D2, Annex I, HA 216/06*)

$$P_{acc} = RL * SS * (AADT * 365 / 10^9) * (HGV\% / 100)$$

(*Method D, Annex I, HA 216/06*)

Risk of Spillage			
$P_{acc\ side\ road}$ =	0.0001		
$P_{acc\ slip}$ =	0.0000		
$P_{acc\ total}$ =	0.0001		
Risk of Pollution P_{pol} =	0.0000		
Return Period 1:	0.0034	%	

Water Quality:			
Copper Concentration			
Total Road Length	300	m	
Road Width	10	m	
Total Impervious Area	3000	m^2	
Runoff Coefficient	0.75		(see justification *Environmental Statement Chapter 15*)
Rainfall Depth	12	mm/day	(Flood Estimation Handbook CD Rom, *Institute of Hydrology, 1999*)
Runoff Volume	27	m^3/day	
Q_{95}	668736	m^3/day	(Blairston Gauging Station)
Dissolved Copper Build-up Rate	0.3	kg/ha/a	(*Table B1, Annex I, HA 216/06*)
Dissolved Copper 5 day Build-up Rate	0.001233	kg	
U/S Dissolved Copper	0.00162	mg/l	(For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)

$$C_r = [(C_b * Q_{95}) + (1000 * M_{cu})] / (Q_{95} + V)$$

(*Method B, Annex I, HA 216/06*)

Dissolved Copper Concentration, $C_{r\ cu}$	0.001622	mg/l	
=	1.621778	µg/L	

Zinc Concentration			
Total Zinc Build-up Rate	1	kg/ha/a	(*Table B1, Annex I, HA 216/06*)
Total Zinc 5 day Build-up Rate	0.00411	kg	
U/S Total Zinc	0.01045	mg/l	(For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)
$C_{r\ Zn}$	0.010456	mg/l	
	10.45572	µg/L	

M74 Junction 5, Raith
Water Quality Calculations

Outfall M004 into Clyde - Raith Junction

Risk of Spillage:		
Road Length < 100m away from side road NAADT	100 m	
Road Length < 100m away from side road SAADT	300 m	
Road Length < 100m away from roundabout (NAADT)	100 m	
Road Length > 100m away from junctions NAADT	20 m	
Road Length < 100m away from roundabout SAADT	100 m	
Serious spillage rate < 100m from side road	1.81	(Figures assume an all purpose urban road.
Serious spillage rate < 100m from roundabout	5.35	*Table D1, Annex I, HA 216/06*)
Serious spillage rate > 100m junctions	0.31	
Northern AADT	55370	
Southern AADT	47916	
HGV traffic	6 %	
Risk Reduction Factor	0.45	(Assuming RE2 - high quality - watercourse classification and < 20min emergency response. *Table D2, Annex I, HA 216/06*)

$$P_{acc} = RL * SS * (AADT * 365 / 10^9) * (HGV\% / 100)$$ (*Method D, Annex I, HA 216/06*)

Risk of Spillage	
$P_{acc\ side\ road\ N} =$	0.0002
$P_{acc\ side\ road\ S} =$	0.0006
$P_{acc\ roundabout\ N} =$	0.0006
$P_{acc\ no\ junction\ N} =$	0.0000
$P_{acc\ roundabout\ S} =$	0.0006
$P_{acc\ total} =$	0.0020
Risk of Pollution $P_{pol} =$	0.0009
Return Period 1:	0.09 %

Water Quality:		
Copper Concentration		
Total Road Length (NAADT)	220 m	
Total Road Length (SAADT)	400 m	
Road Width	17 m	
Impervious Area (NAADT)	3740 m²	
Impervious Area (SAADT)	6800 m²	
Total Impervious Area	10540 m²	
Runoff Coefficient	0.75	(see justification *Environmental Statement Chapter 15*)
Rainfall Depth	12 mm/day	(Flood Estimation Handbook CD Rom, *Institute of Hydrology, 1999*)
Runoff Volume (NAADT)	33.66 m³/day	
Runoff Volume (SAADT)	61.2 m³/day	
Total Runoff Volume	94.86 m³/day	
Q_{95}	668736 m³/day	(Blairston Gauging Station)
Dissolved Copper Build-up Rate	1.2 kg/ha/a	(*Table B1, Annex I, HA 216/06*)
Dissolved Copper 5 day Build-up Rate	0.017326 kg	
U/S Dissolved Copper	0.00162 mg/l	(For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)

$$C_r = [(C_b * Q_{95}) + (1000 * M_{cu})] / (Q_{95} + V)$$ (*Method B, Annex I, HA 216/06*)

Dissolved Copper Concentration, $C_{r\ cu\ (NAADT)}$	0.001646 mg/l
=	1.645675 µg/L

Zinc Concentration		
Total Zinc Build-up Rate	5 kg/ha/a	(*Table B1, Annex I, HA 216/06*)
Total Zinc 5 day Build-up Rate	0.072192 kg	
U/S Total Zinc	0.01045 mg/l	(For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)
$C_{r\ Zn}$ (NAADT)	0.010556 mg/l	
	10.55646 µg/L	

Outfall M006 into Clyde - Raith Junction

Risk of Spillage:		
Road Length < 100m away from slip road NAADT	230 m	
Road Length < 100m from slip CAADT	200 m	
Road Length < 100m from roundabout NBRBT	100 m	
Road Length < 100m from roundabout SBRBT	70 m	
Road Length < 100m from roundabout SAADT	30 m	
Road Length < 100m from slip road SAADT (12m)	250 m	
Road Length < 100m from slip road SAADT (6m)	280 m	
Serious spillage rate < 100m from slip road	0.36	(Figures assume an all purpose urban road.
Serious spillage rate < 100m from roundabout	5.35	*Table D1, Annex I, HA 216/06*)
Northern AADT	23400	
Central AADT	10880	
North Bound to Roundabout	12532	
South Bound from Roundabout	14121	
Southern AADT	25009	
HGV traffic (NAADT/SAADT)	11 %	
HGV traffic (CAADT)	8 %	
HGV traffic (NBRBT)	13 %	
HGV traffic (SBRBT)	12 %	
Risk Reduction Factor	0.45	(Assuming RE2 - high quality - watercourse classification and < 20min emergency response. *Table D2, Annex I, HA 216/06*)

$$P_{acc} = RL * SS * (AADT * 365 / 10^9) * (HGV\% / 100)$$

(*Method D, Annex I, HA 216/06*)

Risk of Spillage

$P_{acc\ slip\ road\ N}$ =	0.000078
$P_{acc\ slip\ road\ C}$ =	0.000023
$P_{acc\ roundabout\ NB}$ =	0.000318
$P_{acc\ roundabout\ SB}$ =	0.000232
$P_{acc\ roundabout\ S}$ =	0.000161
$P_{acc\ slip\ road\ S}$ =	0.000192
$P_{acc\ total}$ =	0.001003
Risk of Pollution P_{pol} =	0.0005
Return Period 1:	0.05 %

Water Quality:

Copper Concentration

Total Road Length (NAADT)	230 m	
Total Road Length (CAADT)	200 m	
Total Road Length (NBRBT)	100 m	
Total Road Length (SBRBT)	70 m	
Total Road Length (SAADT 12m)	280 m	
Total Road Length (SAADT 6m)	280 m	
Road Width (NAADT)	13 m	
Road Width (CAADT/NBRBT)	7.3 m	
Road Width (SBRBT)	4.5 m	
Road Width (SAADT 12m)	12 m	
Road Width (SAADT 6m)	6 m	
Impervious Area (NAADT)	2990 m^2	
Impervious Area (CAADT)	1460 m^2	
Impervious Area (NBRBT)	730 m^2	
Impervious Area (SBRBT)	315 m^2	
Impervious Area (SAADT 12m)	3360 m^2	
Impervious Area (SAADT 6m)	1680 m^2	
Total Impervious Area	10535 m^2	
Runoff Coefficient	0.75	(see justification *Environmental Statement Chapter 15*)
Rainfall Depth	12 mm/day	(Flood Estimation Handbook CD Rom, *Institute of*
Runoff Volume (NAADT/SAADT)	72.27 m^3/day	*Hydrology, 1999*)
Runoff Volume (CAADT/NBRBT/SBRBT)	22.545 m^3/day	
Total Runoff Volume	94.815 m^3/day	
Q$_{95}$	668736 m^3/day	(Blairston Gauging Station)
Dissolved Copper Build-up Rate (NAADT/SAADT)	0.4 kg/ha/a	(*Table B1, Annex I, HA 216/06*)
Dissolved Copper Build-up Rate ($_{CAADT/NBRBT/SBRBT}$)	0.3 kg/ha/a	
Dissolved Copper 5 day Build-up Rate ($_{NAADT/SAADT}$)	0.0044 kg	
Dissolved Copper 5 day Build-up Rate ($_{CAADT/NBRBT/SBRBT}$)	0.0010295 kg	
Total Dissolved Copper 5 day build-up	0.0054295 kg	
U/S Dissolved Copper	0.00162 mg/l	(For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)

$$C_r = [(C_b * Q_{95}) + (1000 * M_{cu})] / (Q_{95} + V)$$ (*Method B, Annex I, HA 216/06*)

Dissolved Copper Concentration, C$_{r\ cu\ (NAADT)}$	0.0016279 mg/l	
=	1.6278882 µg/L	

Zinc Concentration

Total Zinc Build-up Rate (NAADT/SAADT)	2 kg/ha/a	(*Table B1, Annex I, HA 216/06*)
Total Zinc Build-up Rate ($_{CAADT/NBRBT/SBRBT}$)	1 kg/ha/a	
Total Zinc 5 day Build-up Rate (NAADT/SAADT)	0.022 kg	
Total Zinc 5 day Build-up Rate ($_{CAADT/NBRBT/SBRBT}$)	0.0034315 kg	
Total Zinc 5 day build-up	0.0254315 kg	
U/S Total Zinc	0.01045 mg/l	(For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)
C$_{r\ Zn}$ (NAADT)	0.0104865 mg/l	
	10.486542 µg/L	

M74 Junction 5, Raith
Water Quality Calculations

Outfall M009 into Clyde - Raith Junction

Risk of Spillage:			
Road Length < 100m away from roundabout	110	m	
Serious spillage rate < 100m from roundabout	5.35		(Figures assume an all purpose urban road.
AADT	21317		*Table D1, Annex I, HA 216/06*)
Assume 10% HGV traffic	11	%	
Risk Reduction Factor	0.45		(Assuming RE2 - high quality - watercourse

classification and < 20min emergency response. *Table D2, Annex I, HA 216/06*)

$$P_{acc} = RL * SS * (AADT * 365 / 10^9) * (HGV\% / 100)$$

(*Method D, Annex I, HA 216/06*)

Risk of Spillage

$P_{acc\ roundabout} =$ 0.0005

$P_{acc\ total} =$ 0.0005

Risk of Pollution $P_{pol} =$ 0.0002

Return Period   1:   0.02   %

Water Quality:

Copper Concentration

Total Road Length	110	m	
Road Width	7	m	
Total Impervious Area	770	m^2	
Runoff Coefficient	0.75		(see justification *Environmental Statement Chapter 15*)
Rainfall Depth	12	mm/day	(Flood Estimation Handbook CD Rom, *Institute of*
Runoff Volume	6.93	m^3/day	*Hydrology, 1999*)
Q_{95}	668736	m^3/day	(Blairston Gauging Station)
Dissolved Copper Build-up Rate	0.4	kg/ha/a	(*Table B1, Annex I, HA 216/06*)
Dissolved Copper 5 day Build-up Rate	0.000422	kg	
U/S Dissolved Copper	0.00162	mg/l	(For the river Clyde @ Bothwell Bridge,

SEPA Water Quality Data)

$$C_r = [(C_b * Q_{95}) + (1000 * M_{cu})] / (Q_{95} + V)$$

(*Method B, Annex I, HA 216/06*)

Dissolved Copper Concentration, $C_{r\ cu}$ 0.001621 mg/l

=   1.620614 µg/L

Zinc Concentration

Total Zinc Build-up Rate	2	kg/ha/a	(*Table B1, Annex I, HA 216/06*)
Total Zinc 5 day Build-up Rate	0.00211	kg	
U/S Total Zinc	0.01045	mg/l	(For the river Clyde @ Bothwell Bridge,

SEPA Water Quality Data)

$C_{r\ Zn}$ 0.010453 mg/l

   10.45305 µg/L

Outfall M011 into Clyde - Raith Junction

Risk of Spillage:

Road Length < 100m away from slip road	220	m
Road Length > 100m away from junctions	190	m
Serious spillage rate < 100m from slip rd	0.36	(Figures assume an all purpose urban road.
Serious spillage rate > 100m from junctions	0.31	*Table D1, Annex I, HA 216/06*)
AADT	22245	
HGV traffic	9 %	
Risk Reduction Factor	0.45	(Assuming RE2 - high quality - watercourse classification and < 20min emergency response. *Table D2, Annex I, HA 216/06*)

$$P_{acc} = RL * SS * (AADT * 365 / 10^9) * (HGV\% / 100)$$

(*Method D, Annex I, HA 216/06*)

Risk of Spillage

$P_{acc\ slip}$ =	0.000058
$P_{acc\ no\ junc.}$ =	0.000043
$P_{acc\ total}$ =	0.000101
Risk of Pollution P_{pol} =	0.0000
Return Period 1:	0.00 %

Water Quality:

Copper Concentration

Total Road Length	410	m
Road Width	7	m
Total Impervious Area	2870	m^2
Runoff Coefficient	0.75	(see justification *Environmental Statement Chapter 15*)
Rainfall Depth	12	mm/day (Flood Estimation Handbook CD Rom, *Institute of*
Runoff Volume	25.83	m^3/day *Hydrology, 1999*)
Q_{95}	668736	m^3/day (Blairston Gauging Station)
Dissolved Copper Build-up Rate	0.4	kg/ha/a (*Table B1, Annex I, HA 216/06*)
Dissolved Copper 5 day Build-up Rate	0.0015726	kg
U/S Dissolved Copper	0.00162	mg/l (For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)

$$C_r = [(C_b * Q_{95}) + (1000 * M_{cu})] / (Q_{95} + V)$$

(*Method B, Annex I, HA 216/06*)

Dissolved Copper Concentration, $C_{r\ cu}$	0.0016223	mg/l
=	1.6222889	µg/L

Zinc Concentration

Total Zinc Build-up Rate	2	kg/ha/a (*Table B1, Annex I, HA 216/06*)
Total Zinc 5 day Build-up Rate	0.007863	kg
U/S Total Zinc	0.01045	mg/l (For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)
$C_{r\ Zn}$	0.0104614	mg/l
	10.461354	µg/L

Outfall M014 into Clyde - Raith Junction

Risk of Spillage:

Road Length < 100m away from roundabout	80	m
Road Length < 100m away from slip rd	290	m
Road Length > 100m away from junctions	50	m
Serious spillage rate < 100m from roundabout	5.35	(Figures assume an all purpose urban road.
Serious spillage rate < 100m from slip rd	0.36	*Table D1, Annex I, HA 216/06*)
Serious spillage rate > 100m junctions	0.31	
AADT (M74)	5444	
AADT (Rbt)	15332	
HGV traffic (M74)	17 %	
HGV traffic (Rbt)	11 %	
Risk Reduction Factor	0.45	(Assuming RE2 - high quality - watercourse classification and < 20min emergency response. *Table D2, Annex I, HA 216/06*)

$$P_{acc} = RL * SS * (AADT * 365 / 10^9) * (HGV\% / 100)$$ (*Method D, Annex I, HA 216/06*)

Risk of Spillage

$P_{acc\ roundabout} =$	0.0003
$P_{acc\ slip} =$	0.0000
$P_{acc\ no\ junction} =$	0.0000
$P_{acc\ total} =$	0.0003
Risk of Pollution $P_{pol} =$	0.0001
Return Period 1:	0.014 %

Water Quality:

Copper Concentration

Total Road Length	420	m
Road Width	7	m
Total Impervious Area	2940	m^2
Runoff Coefficient	0.75	(see justification *Environmental Statement Chapter 15*)
Rainfall Depth	12	mm/day (Flood Estimation Handbook CD Rom, *Institute of*
Runoff Volume	26.46	m^3/day *Hydrology, 1999*)
Q_{95}	668736	m^3/day (Blairston Gauging Station)
Dissolved Copper Build-up Rate (AADT M74)	0.3	kg/ha/a (*Table B1, Annex I, HA 216/06*)
Dissolved Copper Build-up Rate (AADT Rbt)	0.4	kg/ha/a
Dissolved Copper 5 day Build-up Rate	0.002819	kg
U/S Dissolved Copper	0.00162	mg/l (For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)

$$C_r = [(C_b * Q_{95}) + (1000 * M_{cu})] / (Q_{95} + V)$$ (*Method B, Annex I, HA 216/06*)

Dissolved Copper Concentration, $C_{r\ cu}$	0.001624	mg/l
=	1.624151	µg/L

Zinc Concentration

Total Zinc Build-up Rate (AADT M74)	1	kg/ha/a (*Table B1, Annex I, HA 216/06*)
Total Zinc Build-up Rate (AADT Rbt)	2	kg/ha/a
Total Zinc 5 day Build-up Rate	0.012082	kg
U/S Total Zinc	0.01045	mg/l (For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)
$C_{r\ Zn}$	0.010468	mg/l
	10.46765	µg/L

Outfall MR0I_210 into Clyde - Raith Junction

Risk of Spillage:			
Road Length Roundabout A	50	m	
Road Length Roundabout B	30	m	
Road Length Roundabout C	40	m	
Road Length Roundabout D	140	m	
Road Length Roundabout E	60	m	
Road Length Roundabout F	60	m	
Serious spillage rate < 100m from roundabout	5.35		(Figures assume an all purpose urban road.
AADT A	52243		*Table D1, Annex I, HA 216/06*)
AADT B	49699		
AADT C	51678		
AADT D	30360		
AADT E	42871		
AADT F	28750		
HGV traffic (A/C/E/F)	9	%	
HGV traffic (B)	10	%	
HGV traffic (D)	8	%	
Risk Reduction Factor	0.45		(Assuming RE2 - high quality - watercourse classification and < 20min emergency response. *Table D2, Annex I, HA 216/06*)

$$P_{acc} = RL * SS * (AADT * 365 / 10^9) * (HGV\% / 100)$$

(*Method D, Annex I, HA 216/06*)

Risk of Spillage	
$P_{acc\ A}$ =	0.000459
$P_{acc\ B}$ =	0.000291
$P_{acc\ C}$ =	0.000363
$P_{acc\ D}$ =	0.000664
$P_{acc\ E}$ =	0.000452
$P_{acc\ F}$ =	0.000303
$P_{acc\ total}$ =	0.002533
Risk of Pollution P_{pol} =	0.0011
Return Period 1:	0.11 %

Water Quality:

Copper Concentration

Total Road Length A	50 m	
Total Road Length B	30 m	
Total Road Length C	40 m	
Total Road Length D	140 m	
Total Road Length E	60 m	
Total Road Length F	60 m	
Road Width (A/B/C/E/F)	11 m	
Road Width (D)	7.5 m	
Impervious Area A	550 m^2	
Impervious Area B	330 m^2	
Impervious Area C	440 m^2	
Impervious Area D	1050 m^2	
Impervious Area E	660 m^2	
Impervious Area F	660 m^2	
Total Impervious Area	3690 m^2	
Runoff Coefficient	0.75	(see justification *Environmental Statement Chapter 15*)
Rainfall Depth	12 mm/day	(Flood Estimation Handbook CD Rom, *Institute of*
Runoff Volume A	4.95 m^3/day	*Hydrology, 1999*)
Runoff Volume B	2.97 m^3/day	
Runoff Volume C	3.96 m^3/day	
Runoff Volume D	9.45 m^3/day	
Runoff Volume E	5.94 m^3/day	
Runoff Volume F	5.94 m^3/day	
Total Runoff Volume	33.21 m^3/day	
Q_{95}	668736 m^3/day	(Blairston Gauging Station)
Dissolved Copper Build-up Rate A	1.2 kg/ha/a	(*Table B1, Annex I, HA 216/06*)
Dissolved Copper Build-up Rate B	1.2 kg/ha/a	
Dissolved Copper Build-up Rate C	1.2 kg/ha/a	
Dissolved Copper Build-up Rate D	1.2 kg/ha/a	
Dissolved Copper Build-up Rate E	1.2 kg/ha/a	
Dissolved Copper Build-up Rate F	0.4 kg/ha/a	
Dissolved Copper 5 day Build-up Rate A	0.000904 kg	
Dissolved Copper 5 day Build-up Rate B	0.000542 kg	
Dissolved Copper 5 day Build-up Rate C	0.000723 kg	
Dissolved Copper 5 day Build-up Rate D	0.001726 kg	
Dissolved Copper 5 day Build-up Rate E	0.001085 kg	
Dissolved Copper 5 day Build-up Rate F	0.000362 kg	
Total Dissolved Copper 5 day Build-up	0.005342 kg	
U/S Dissolved Copper	0.00162 mg/l	(For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)

$$C_r = [(C_b * Q_{95}) + (1000 * M_{cu})] / (Q_{95} + V)$$ (*Method B, Annex I, HA 216/06*)

Dissolved Copper Concentration, $C_{r\,cu\,(A)}$	0.001628 mg/l	
=	1.627908 µg/L	

Zinc Concentration

Total Zinc Build-up Rate A	5 kg/ha/a	(*Table B1, Annex I, HA 216/06*)
Total Zinc Build-up Rate B	5 kg/ha/a	
Total Zinc Build-up Rate C	5 kg/ha/a	
Total Zinc Build-up Rate D	5 kg/ha/a	
Total Zinc Build-up Rate E	5 kg/ha/a	
Total Zinc Build-up Rate F	2 kg/ha/a	
Total Zinc 5 day Build-up Rate A	0.003767 kg	
Total Zinc 5 day Build-up Rate B	0.00226 kg	
Total Zinc 5 day Build-up Rate C	0.003014 kg	
Total Zinc 5 day Build-up Rate D	0.007192 kg	
Total Zinc 5 day Build-up Rate E	0.004521 kg	
Total Zinc 5 day Build-up Rate F	0.001808 kg	
Total Zinc 5 day build-up	0.022562 kg	
U/S Total Zinc	0.01045 mg/l	(For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)
$C_{r\,Zn\,(A)}$	0.010483 mg/l	
	10.48322 µg/L	

Outfall MROI_580 into Clyde - Raith Junction

Risk of Spillage:			
Road Length Roundabout V	30	m	
Road Length Roundabout W	90	m	
Road Length Roundabout X	140	m	
Road Length Roundabout Y	50	m	
Road Length Roundabout Z	90	m	
Serious spillage rate < 100m from roundabout	5.35		(Figures assume an all purpose urban road.
AADT V	14290		*Table D1, Annex I, HA 216/06*)
AADT W	32953		
AADT X	27969		
AADT Y	43162		
AADT Z	27830		
HGV traffic (V)	21	%	
HGV traffic (W/X/Z)	9	%	
HGV traffic (Y)	10	%	
Risk Reduction Factor	0.45		(Assuming RE2 - high quality - watercourse classification and < 20min emergency response. *Table D2, Annex I, HA 216/06*)

$$P_{acc} = RL * SS * (AADT * 365 / 10^9) * (HGV\% / 100)$$

(*Method D, Annex I, HA 216/06*)

Risk of Spillage		
$P_{acc\ V}$ =	0.000176	
$P_{acc\ W}$ =	0.000521	
$P_{acc\ X}$ =	0.000688	
$P_{acc\ Y}$ =	0.000421	
$P_{acc\ Z}$ =	0.000440	
$P_{acc\ total}$ =	0.002247	
Risk of Pollution P_{pol} =	0.0010	
Return Period 1:	0.10	%

Water Quality:

Copper Concentration

Total Road Length V	30	m
Total Road Length W	90	m
Total Road Length X	140	m
Total Road Length Y	50	m
Total Road Length Z	90	m
Road Width	11	m
Impervious Area V	330	m^2
Impervious Area W	990	m^2
Impervious Area X	1540	m^2
Impervious Area Y	550	m^2
Impervious Area Z	990	m^2
Total Impervious Area	4400	m^2
Runoff Coefficient	0.75	(see justification *Environmental Statement Chapter 15*)
Rainfall Depth	12	mm/day (Flood Estimation Handbook CD Rom, *Institute of*
Runoff Volume V	2.97	m^3/day *Hydrology, 1999*)
Runoff Volume W	8.91	m^3/day
Runoff Volume X	13.86	m^3/day
Runoff Volume Y	4.95	m^3/day
Runoff Volume Z	8.91	m^3/day
Total Runoff Volume	39.6	m^3/day
Q_{95}	668736	m^3/day (Blairston Gauging Station)
Dissolved Copper Build-up Rate V	0.3	kg/ha/a (*Table B1, Annex I, HA 216/06*)
Dissolved Copper Build-up Rate W	1.2	kg/ha/a
Dissolved Copper Build-up Rate X	0.4	kg/ha/a
Dissolved Copper Build-up Rate Y	1.2	kg/ha/a
Dissolved Copper Build-up Rate Z	0.4	kg/ha/a
Dissolved Copper 5 day Build-up Rate V	0.0001356	kg
Dissolved Copper 5 day Build-up Rate W	0.0016274	kg
Dissolved Copper 5 day Build-up Rate X	0.0008438	kg
Dissolved Copper 5 day Build-up Rate Y	0.0009041	kg
Dissolved Copper 5 day Build-up Rate Z	0.0005425	kg
Total Dissolved Copper 5 Day Build-up	0.0040534	kg
U/S Dissolved Copper	0.00162	mg/l (For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)

$$C_r = [(C_b * Q_{95}) + (1000 * M_{cu})] / (Q_{95} + V)$$

(*Method B, Annex I, HA 216/06*)

Dissolved Copper Concentration, $C_{r\ cu\ (V)}$	0.001626	mg/l
=	1.625965	µg/L

Zinc Concentration

Total Zinc Build-up Rate V	1	kg/ha/a (*Table B1, Annex I, HA 216/06*)
Total Zinc Build-up Rate W	5	kg/ha/a
Total Zinc Build-up Rate X	2	kg/ha/a
Total Zinc Build-up Rate Y	5	kg/ha/a
Total Zinc Build-up Rate Z	2	kg/ha/a
Total Zinc 5 day Build-up Rate V	0.0004521	kg
Total Zinc 5 day Build-up Rate W	0.0067808	kg
Total Zinc 5 day Build-up Rate X	0.0042192	kg
Total Zinc 5 day Build-up Rate Y	0.0037671	kg
Total Zinc 5 day Build-up Rate Z	0.0027123	kg
Total Zinc 5 Day Build-up	0.0179315	kg
U/S Total Zinc	0.01045	mg/l (For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)
$C_{r\ Zn\ (V)}$	0.0104762	mg/l
	10.476194	µg/L

M74 Junction 5, Raith
Water Quality Calculations

<u>**Entrance and Exit Strathclyde Country Park To Clyde - Raith Junction**</u>

Risk of Spillage:

Road Length < 100m away from slip rd	70 m	
Serious spillage rate < 100m from slip rd	0.36	(Figures assume an all purpose urban road.
AADT	4522	*Table D1, Annex I, HA 216/06*)
HGV traffic	2 %	
Risk Reduction Factor	0.45	(Assuming RE2 - high quality - watercourse

classification and < 20min emergency response. *Table D2, Annex I, HA 216/06*)

$$P_{acc} = RL * SS * (AADT * 365 / 10^9) * (HGV\% / 100)$$ (*Method D, Annex I, HA 216/06*)

Risk of Spillage
$P_{acc\ slip} =$ 0.0000
$P_{acc\ total} =$ 0.0000

Risk of Pollution $P_{pol} =$ 0.0000

Return Period 1: 0.00 %

Water Quality:

Copper Concentration

Total Road Length	70 m	
Road Width	10 m	
Total Impervious Area	700 m^2	
Runoff Coefficient	0.75	(see justification *Environmental Statement Chapter 15*)
Rainfall Depth	12 mm/day	(Flood Estimation Handbook CD Rom, *Institute of*
Runoff Volume	6.3 m^3/day	*Hydrology, 1999*)
Q_{95}	668736 m^3/day	(Blairston Gauging Station)
Dissolved Copper Build-up Rate	0.2 kg/ha/a	(*Table B1, Annex I, HA 216/06*)
Dissolved Copper 5 day Build-up Rate	0.000192 kg	
U/S Dissolved Copper	0.00162 mg/l	(For the river Clyde @ Bothwell Bridge,

SEPA Water Quality Data)

$$C_r = [(C_b * Q_{95}) + (1000 * M_{cu})] / (Q_{95} + V)$$ (*Method B, Annex I, HA 216/06*)

Dissolved Copper Concentration, $C_{r\ cu}$ 0.00162 mg/l
= 1.620272 µg/L

Zinc Concentration

Total Zinc Build-up Rate	0.4 kg/ha/a	(*Table B1, Annex I, HA 216/06*)
Total Zinc 5 day Build-up Rate	0.000384 kg	
U/S Total Zinc	0.01045 mg/l	(For the river Clyde @ Bothwell Bridge,

SEPA Water Quality Data)

$C_{r\ Zn}$ 0.01045 mg/l
10.45048 µg/L

M74 North Bound On Slip from Roundabout into Clyde - Raith Junction

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Risk of Spillage:

Road Length < 100m away from roundabout	100	m
Road Length < 100m away from slip rd	60	m
Serious spillage rate < 100m from roundabout	5.35	(Figures assume an all purpose urban road.
Serious spillage rate < 100m from slip rd	0.36	*Table D1, Annex I, HA 216/06*)
AADT	4984	
HGV traffic	9 %	
Risk Reduction Factor	0.45	(Assuming RE2 - high quality - watercourse classification and < 20min emergency response. *Table D2, Annex I, HA 216/06*)

$$P_{acc} = RL * SS * (AADT * 365 / 10^9) * (HGV\% / 100)$$

(*Method D, Annex I, HA 216/06*)

Risk of Spillage

$P_{acc\ roundabout}$ =	0.000088
$P_{acc\ slip}$ =	0.000004
$P_{acc\ total}$ =	0.000091

Risk of Pollution P_{pol} =	0.0000

Return Period	1:	0.00	yrs

Water Quality:

Copper Concentration

Total Road Length	160	m
Road Width	6	m
Total Impervious Area	960	m^2
Runoff Coefficient	0.75	(see justification *Environmental Statement Chapter 15*)
Rainfall Depth	12	mm/day (Flood Estimation Handbook CD Rom, *Institute of*
Runoff Volume	8.64	m^3/day *Hydrology, 1999*)
Q_{95}	668736	m^3/day (Blairston Gauging Station)
Dissolved Copper Build-up Rate	0.2	kg/ha/a (*Table B1, Annex I, HA 216/06*)
Dissolved Copper 5 day Build-up Rate	0.000263	kg
U/S Dissolved Copper	0.00162	mg/l (For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)

$$C_r = [(C_b * Q_{95}) + (1000 * M_{cu})] / (Q_{95} + V)$$

(*Method B, Annex I, HA 216/06*)

Dissolved Copper Concentration, $C_{r\ cu}$	0.0016204	mg/l
=	1.6203724	µg/L

Zinc Concentration

Dissolved Zinc Build-up Rate	0.4	kg/ha/a (*Table B1, Annex I, HA 216/06*)
Dissolved Zinc 5 day Build-up Rate	0.000526	kg
U/S Dissolved Zinc	0.01045	mg/l (For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)
$C_{r\ Zn}$	0.0104507	mg/l
	10.450652	µg/L

A725 Southbound Off-slip into Clyde - Raith Junction

Risk of Spillage:

Road Length < 100m away from slip rd	270	m
Road Length < 100m away from junctions	140	m
Road Length > 100m away from roundabout	100	m
Serious spillage rate < 100m from slip rd	0.36	(Figures assume an all purpose urban road.
Serious spillage rate < 100m from junctions	0.31	*Table D1, Annex I, HA 216/06*)
Serious spillage rate > 100m roundabout	5.35	
AADT	24413	
Assume 10% HGV traffic	9 %	
Risk Reduction Factor	0.45	(Assuming RE2 - high quality - watercourse classification and < 20min emergency response. *Table D2, Annex I, HA 216/06*)

$$P_{acc} = RL * SS * (AADT * 365 / 10^9) * (HGV\% / 100)$$ (*Method D, Annex I, HA 216/06*)

Risk of Spillage

$P_{acc\ slip\ rd}$ =	0.000078	
$P_{acc\ no\ junctions}$ =	0.000035	
$P_{acc\ roundabout}$ =	0.000429	
$P_{acc\ total}$ =	0.000542	
Risk of Pollution P_{pol} =	0.0002	
Return Period 1:	0.02	%

Water Quality:

Copper Concentration

Total Road Length	510	m
Road Width	8	m
Total Impervious Area	4080	m²
Runoff Coefficient	0.75	(see justification *Environmental Statement Chapter 15*)
Rainfall Depth	12	mm/day (Flood Estimation Handbook CD Rom, *Institute of*
Runoff Volume	36.72	m³/day *Hydrology, 1999*)
Q_{95}	668736	m³/day (Blairston Gauging Station)
Dissolved Copper Build-up Rate	0.4	kg/ha/a (*Table B1, Annex I, HA 216/06*)
Dissolved Copper 5 day Build-up Rate	0.0022356	kg
U/S Dissolved Copper	0.00162	mg/l (For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)

$$C_r = [(C_b * Q_{95}) + (1000 * M_{cu})] / (Q_{95} + V)$$ (*Method B, Annex I, HA 216/06*)

Dissolved Copper Concentration, $C_{r\ cu}$	0.0016233	mg/l
=	1.6232539	µg/L

Zinc Concentration

Dissolved Zinc Build-up Rate	2	kg/ha/a (*Table B1, Annex I, HA 216/06*)
Dissolved Zinc 5 day Build-up Rate	0.0111781	kg
U/S Dissolved Zinc	0.01045	mg/l (For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)
$C_{r\ Zn}$	0.0104661	mg/l
	10.466141	µg/L

M74 Junction 5, Raith
Water Quality Calculations

M74 Southbound to Roundabout into Clyde - Raith Junction

Risk of Spillage:

Road Length < 100m away from slip rd (combined)	30	m
Road Length < 100m away from slip rd (split)	120	m
Road Length > 100m away from roundabout	100	m
Serious spillage rate < 100m from slip rd	0.36	(Figures assume an all purpose urban road.
Serious spillage rate < 100m from roundabout	5.35	*Table D1, Annex I, HA 216/06*)
AADT (combined)	20638	
AADT (split)	15194	
HGV traffic	11 %	
Risk Reduction Factor	0.45	(Assuming RE2 - high quality - watercourse classification and < 20min emergency response. *Table D2, Annex I, HA 216/06*)

$$P_{acc} = RL * SS * (AADT * 365 / 10^9) * (HGV\% / 100)$$
(*Method D, Annex I, HA 216/06*)

Risk of Spillage

$P_{acc\ slip\ combined} =$	0.0000	
$P_{acc\ slip\ split} =$	0.0000	
$P_{acc\ roundabout} =$	0.0003	
$P_{acc\ total} =$	0.0004	
Risk of Pollution $P_{pol} =$	0.0002	
Return Period 1:	0.02	%

Water Quality:

Copper Concentration

Total Road Length	250	m
Road Width	8	m
Total Impervious Area	2000	m^2
Runoff Coefficient	0.75	(see justification *Environmental Statement Chapter 15*)
Rainfall Depth	12	mm/day (Flood Estimation Handbook CD Rom, *Institute of*
Runoff Volume	18	m^3/day *Hydrology, 1999*)
Q$_{95}$	668736	m^3/day (Blairston Gauging Station)
Dissolved Copper Build-up Rate	0.4	kg/ha/a (*Table B1, Annex I, HA 216/06*)
Dissolved Copper 5 day Build-up Rate	0.001096	kg
U/S Dissolved Copper	0.00162	mg/l (For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)

$$C_r = [(C_b * Q_{95}) + (1000 * M_{cu})] / (Q_{95} + V)$$
(*Method B, Annex I, HA 216/06*)

Dissolved Copper Concentration, $C_{r\ cu}$	0.001622	mg/l
=	1.621595	µg/L

Zinc Concentration

Dissolved Zinc Build-up Rate	2	kg/ha/a (*Table B1, Annex I, HA 216/06*)
Dissolved Zinc 5 day Build-up Rate	0.005479	kg
U/S Dissolved Zinc	0.01045	mg/l (For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)
$C_{r\ Zn}$	0.010458	mg/l
	10.45791	µg/L

Combined A725 North Bound On-slip into Clyde - Raith Junction

Risk of Spillage:		
Road Length < 100m away from slip rd	380	m
Road Length < 100m away from roundabout	20	m
Serious spillage rate < 100m from slip rd	0.36	(Figures assume an all purpose urban road.
Serious spillage rate < 100m from roundabout	5.35	*Table D1, Annex I, HA 216/06*)
AADT	20776	
HGV traffic	13 %	
Risk Reduction Factor	0.45	(Assuming RE2 - high quality - watercourse classification and < 20min emergency response. *Table D2, Annex I, HA 216/06*)

$$P_{acc} = RL * SS * (AADT * 365 / 10^9) * (HGV\% / 100)$$ (*Method D, Annex I, HA 216/06*)

Risk of Spillage		
$P_{acc\ slip\ rd}$ =	0.0001	
$P_{acc\ roundabout}$ =	0.0001	
$P_{acc\ total}$ =	0.0002	
Risk of Pollution P_{pol} =	0.0001	
Return Period 1:	0.01	%

Water Quality:		
Copper Concentration		
Total Road Length	400	m
Road Width	8	m
Total Impervious Area	3200	m²
Runoff Coefficient	0.75	(see justification *Environmental Statement Chapter 15*)
Rainfall Depth	12	mm/day (Flood Estimation Handbook CD Rom, *Institute of*
Runoff Volume	28.8	m³/day *Hydrology, 1999*)
Q_{95}	668736	m³/day (Blairston Gauging Station)
Dissolved Copper Build-up Rate	0.4	kg/ha/a (*Table B1, Annex I, HA 216/06*)
Dissolved Copper 5 day Build-up Rate	0.001753	kg
U/S Dissolved Copper	0.00162	mg/l (For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)

$$C_r = [(C_b * Q_{95}) + (1000 * M_{cu})] / (Q_{95} + V)$$ (*Method B, Annex I, HA 216/06*)

Dissolved Copper Concentration, $C_{r\ cu}$	0.001623	mg/l
=	1.622552	µg/L

Zinc Concentration		
Dissolved Zinc Build-up Rate	2	kg/ha/a (*Table B1, Annex I, HA 216/06*)
Dissolved Zinc 5 day Build-up Rate	0.008767	kg
U/S Dissolved Zinc	0.01045	mg/l (For the river Clyde @ Bothwell Bridge, *SEPA Water Quality Data*)
$C_{r\ Zn}$	0.010463	mg/l
	10.46266	µg/L

Summary of Alternative Option D - Clyde / Burn

Outfall	U/S Concn Copper	D/S Concn Copper	Difference	U/S Concn Zinc	D/S Concn Zinc	Difference	EQS Cu*	EQS Zn*
Clyde	1.62 ug/l	1.75 ug/l	0.13 ug/l	10.5 ug/l	11.01 ug/l	0.6 ug/l	28 ug/l	75 ug/l

*EQS Cu and Zn based on statutory figures for Clyde water hardness 105mg/l

Gully/Carrier Pipe System

Outfall	% of Disolved Copper Removed	Removed Concn of Copper**	D/S Concn after Treatment	Difference between U/S and D/S	% of Disolved Zinc Removed	Removed Concn of Zinc	D/S Concn after Treatment	Difference between U/S and D/S
Clyde	0%	0.00 ug/l	1.75 ug/l	0.13 ug/l	0%	0.00 ug/l	11.01 ug/l	0.56 ug/l

If oil separation tanks were to be used it may have the following effect

Outfall	% of Disolved Copper Removed	Removed Concn of Copper**	D/S Concn after Treatment	Difference between U/S and D/S	% of Disolved Zinc Removed	Removed Concn of Zinc	D/S Concn after Treatment	Difference between U/S and D/S
Clyde	0%	0.00 ug/l	1.75 ug/l	0.13 ug/l	0%	0.00 ug/l	11.01 ug/l	0.56 ug/l

If an additional treatment system such as a sedimentation lagoon was to be used it may result in the following

Outfall	% of Disolved Copper Removed	Removed Concn of Copper**	D/S Concn after Treatment	Difference between U/S and D/S	% of Disolved Zinc Removed	Removed Concn of Zinc	D/S Concn after Treatment	Difference between U/S and D/S
Clyde	20%	0.03 ug/l	1.72 ug/l	0.10 ug/l	60%	0.33 ug/l	10.67 ug/l	0.22 ug/l

Biofiltration Technique

Outfall	% of Disolved Copper Removed	Removed Concn of Copper**	D/S Concn after Treatment	Difference between U/S and D/S	% of Disolved Zinc Removed	Removed Concn of Zinc	D/S Concn after Treatment	Difference between U/S and D/S
Clyde	10%	0.01 ug/l	1.71 ug/l	0.09 ug/l	30%	0.07 ug/l	10.61 ug/l	0.16 ug/l

Swales

Outfall	% of Disolved Copper Removed	Removed Concn of Copper**	D/S Concn after Treatment	Difference between U/S and D/S	% of Disolved Zinc Removed	Removed Concn of Zinc	D/S Concn after Treatment	Difference between U/S and D/S
Clyde	0%	0.00 ug/l	1.71 ug/l	0.09 ug/l	0%	0.00 ug/l	10.61 ug/l	0.16 ug/l

Pollution Risks

Outfall	Pr (serious accident Spill)	Risk of Serious Polution Incident	Probability of Serious Pollution Incident Per Year	Return Period of Serious Pollution Incident Per Year after Mitigation
Clyde	0.01088	0.0049	0.49 %	0.18 %