CALCULATIONS

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DMRB HA 216/06 Annex 1

WATER RESOURCES CHAPTER – DMRB WATER QUALITY CALCULATIONS

METHOD A

$V_R \Rightarrow Q95 = 40m^3/d$ (see low flow calculation attached)

AADT (Two-way) = Existing traffic flow * NRTF Growth Factor

Chapter 2 ES

= 15,000 * 1.292
= 19,380

$V_H \Rightarrow$ Rainfall = 13mm/day (Figure A.1)

Run off Coefficient = 0.5

Road area = 1200 * 7.5m
(Length) (Carriageway width)

$V_H = 0.5 * (13 \div 1000) * (1200 * 7.5)$
$= 58.5m^3$

Based on $V_R/V_H = \frac{40}{58.5} = 0.68$ r
Figure A.2 this immediately puts the watercourse at high risk, and therefore a detailed assessment is required.

METHOD B

Copper

$C_R = [[(C_B * V_R) + (1000 * M)] / (V_R + V_H)]$

Refer to Water Quality Sampling Results Attached

C_B = u/s dissolved Copper = 4 μg/L

$V_R = 40m^3/d$

$M = 0.4 * 5/365 * \left(\frac{1200 * 7.5}{10,000}\right)$
Table B.1

M = 0.005 kg

Buchanan McPherson Hamilton
S4020.078A

(B) Form No Q16A
5.9.97

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	$C_R = \frac{[(4*10^{-3} * 40) + (1000 * 0.005)]}{(40 + 58.5)}$	
	$C_R = 0.052 \, kg/m^3$	
	$C_R = 52 \, \mu g/l$	
Table 2.1 DMRB "A2" = RE2	Compare this to the EQS for an RE 2 watercourse (i.e. assummed water quality of the Loch Oire Outfall Drain) of 40 µg/L (for hardness of < 100mg/L)	
See Water Quality Sample Results	Note – hardness was measured as 100 mg/L.	
	Therefore, this will result in a slight exceedance of the EQS.	>EQS ∴ Some impact.
	ZINC	
	$C_R = [(C_B * V_R) + (1000 * M)] / (V_R + V_H)$	
	C_B = u/s dissolved zinc = 23 µg/L	
	$V_R = 40 m^3/d$	
	$M = 2.0 * 5/365 * \left(\frac{1200 * 7.5}{10,000}\right)$	
	Table B.1	
	$M = 0.025 \, kg$	
	$C_R = \frac{[(23*10^{-3} * 40) + (1000 * 0.025)]}{(40 + 58.5)}$	
	$C_R = 0.263 \, kg/m^3$	
	$C_R = 263 \, \mu g/L$	
Table 2.1 DMRB "A2" = RE2	Compare this to the EQS for an RE2 watercourse (i.e. assummed water quality of the Loch Oire Outfall Drain) of 300 µg/L (for hardness of < 100 mg/L)	
See Water Quality Sample Results	Note – hardness was measured as = 100 mg/L (as above)	
	Therefore, this does not exceed the EQS & is OK.	<EQS ∴ OK

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	Method D	
Pg. 1 of these calcs.	$P_{ACC} = RL * SS * (AADT * 365 * 10^{-9}) * (\%HGV / 100)$ AADT = 19,380 %HGV = 10% (Ref. email from SW Roads Team (D. Mackenzie) dated 20/08/07)	
	The stretch of the A96 under consideration contains:- • Two cross roads • Three side roads In the existing situation, which will become:- • One cross road, & • four side roads Under the proposed scheme.	
Table D.1 *	Assume A96 is a "rural trunk road".	
	Proposed situation	
	P_{ACC} (side roads) $= (4 * 0.3km) * 0.93 * (19380 * 365 * 10^{-9}) * (10/100)$ $= 7.9 * 10^{-4}$	
	P_{ACC} (cross road) $= (1 * 0.4km) * 0.88 * (19380 * 365 * 10^{-9}) * (10/100)$ $= 2.5 * 10^{-4}$	
	P_{ACC} (Trunk Road) $= (1.4 - 1.0) * 0.29 * (19380 * 365 * 10^{-9}) * (10/100)$ (1.4: Total length; 1.0: Length already accounted for above) $= 8.2 * 10^{-5}$	
	P_{ACC} (Total) $= 1.12 * 10^{-3}$	
Table D.2	$P_{INC} = P_{ACC} * P_{POL} = 1.12 * 10^{-3} * 0.6$ $= 6.72 * 10^{-4} = 0.067\% << 1\%$	OK

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Method C

Component No.	Property	Weighting Factor	Site Data	Risk Score	Component Score
1	Traffic density	15	19,380 for 2028	Medium (2)	30
2	Rainfall	15	≈ 800mm (FEH) 1hr rainfall ≈ 33mm (FEH)	Medium (2)	30
3	Soakaway Geometry	15	Filter Drains & Retention Pond	Medium (2)	30
4	Unsaturated Zone	20	Depth <5m under retention pond	High (3)	60
5	Flow Type	20	Mixed fracture & inter-granular flow	Medium (2)	40
6	Effective Grain Size	7.5	Predominantly Coarse Sand	Medium (2)	15
7	Lithology	7.5	1 - 5% Clay Minerals (Est. from GI)	Medium (2)	15

Therefore, the overall score is between 150 → 250 and the groundwater is at a medium risk of impact. ∴ apply mitigation measures.

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Validated ☑
Preliminary ☐

ALcontrol Geochem Analytical Services
Table Of Results

ISO 17025 accredited
M MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number: 07/21421/02/01 **Matrix:** LIQUID
Client: Norwest Holst Ltd **Location:** A96 THREAPLAND
Client Ref. No.: F14909 **Client Contact:** Kenny McLaren

Sample Identity	WS01									Method Code	LoD/Units
Depth (m)	-										
Sample Type	LIQUID										
Sampled Date	22.11.07										
Sample Received Date	03.12.07										
Batch	1										
Sample Number(s)	1-2										
Hardness Total	100									TM152#	<1 mg/l
Arsenic Dissolved (ICP-MS)	<1									TM152#	<1 ug/l
Boron Dissolved (ICP-MS)	16									TM152#	<10 ug/l
Cadmium Dissolved (ICP-MS)	<0.4									TM152#	<0.4 ug/l
Chromium Dissolved (ICP-MS)	4									TM152#	<1 ug/l
Copper Dissolved (ICP-MS)	4									TM152#	<1 ug/l
Iron Dissolved (ICP-MS)	<5									TM152#	<5 ug/l
Lead Dissolved (ICP-MS)	2									TM152#	<1 ug/l
Nickel Dissolved (ICP-MS)	<1									TM152#	<1 ug/l
Selenium Dissolved (ICP-MS)	<1									TM152#	<1 ug/l
Zinc Dissolved (ICP-MS)	23									TM152#	<3 ug/l
Mercury Dissolved (CVAF)	<0.01									TM183#	<0.01 ug/l
Total Alkalinity as CaCO3	100									TM043#	<2 mg/l
BOD	3									TM045#	<1 mg/l
COD	22									TM107#	<5 mg/l
Dissolved Oxygen	9									TM046	<1 mg/l
Conductivity (at 25 deg.C)	0.26									TM120#	<0.014 mS/cm
Sulphate (soluble)	6									TM098#	<3 mg/l
Phosphate (Ortho as PO4)	<0.08									TM100#	<0.08 mg/l
Sulphide										TM101	<0.5 mg/l
Ammoniacal Nitrogen as N	0.2									TM099#	<0.2 mg/l
Hexavalent Chromium										TM151#	<0.03 mg/l
Phenols Monohydric	<0.01									TM062#	<0.01 mg/l
Thiocyanate	<0.05									TM153#	<0.05 mg/l
Total Cyanide	<0.05									TM153#	<0.05 mg/l
Free Cyanide	<0.05									TM153#	<0.05 mg/l
Complex Cyanide	<0.05									TM153#	<0.05 mg/l
pH Value	8.10									TM133#	<1.00 pH Units

Date 18.12.2007

Scheme: A96 Threapland		
Catchment Yield Analysis - Loch Oire Outfall Drain		
Description	**Value**	**Comments**
Basic Data:		
Catchment Area (km^2)	0.750	1:25,000 OS maps
Total Loch Area in Catchment (km^2)	0.060	1:25,000 OS maps and bathymetry survey
Loch Area for Supply Loch only (km2)	0.060	Bathymetry survey
SAAR (mm)	800.00	Average Annual Rainfall Map (Wallingford)
Annual Potential Evapotranspiration (PE), (mm)	400.00	Estimate from previous work
Base Flow Index (BFI)	0.320	Estimate from Scotland BFI Map
Low Flow Duration "D" (days)	0.00	
Low Flow Return Period "RP" (years)	0.00	
Low Flow Probability	#DIV/0!	
Q95(1) :		
Average Daily Flow (ADF or MF), (m^3/s)	0.010	
Average Daily Flow (ADF or MF), (m^3/d)	**822**	
FLAKE, (Loch Area/Catchment Area)	0.080	
Flow Duration Period, (days)	10.00	IoH Report 101
Flow DurationCurve, $(Q95(10))^{½}$	2.35	
Q95(10), (%ADF)	5.51	
log_{10}GRADQ95	-1.91	
GradQ95	0.01	
Q95(1), (%ADF)	4.90	Using Low Flow Studies Report 2.1 (1980)
Q95(1) - (m^3/day)	**40**	

NOTE FEH RECORDS CATCHMENT @ 2.3km²

NOTE FEH RECORDS BFI @ 0.885

∴ Q95 estimated is deemed to be conservative