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Highways

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Cogges Link Road

Preliminary Drainage Design – Outfall and Storage Proposals

B0834600/Doc/PA/CLR/09 April 2008

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**Oxfordshire Highways
Cogges Link Road – Preliminary Drainage Design – Outfall and Storage Proposals**

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1 Introduction

1.1 Aim

- 1.1.1 The purpose of this report is to consider the preliminary drainage proposals and identify outfall and storage lagoon proposals for the Cogges Link Road, including assessing the risk of pollution from surface water runoff.

1.2 Location

- 1.2.1 The Cogges Link Road is situated to the east of the town of Witney in Oxfordshire.
- 1.2.2 The proposed route heads southeast from Witan Way, crossing the channels of the River Windrush to Stanton Harcourt Road between Cogges Estate and the A40 Trunk Road. The route then heads northwards skirting around the Cogges Estate to the B4022 Oxford Hill.

1.3 Geology

- 1.3.1 The geology of the Site is split into two distinct areas either side of Stanton Harcourt Road
- 1.3.2 West of Stanton Harcourt Road the flood plain of the River Windrush has complex geology with superficial layers overlaying Oxford Clay, Kellaway Bed or Cornbrash.
- 1.3.3 East of Stanton Harcourt Road the geology consists primarily of Oxford Clay.
- 1.3.4 For the purposes of these calculations it is therefore assumed that the surface layers are classified as having a very low permeability.

1.4 Drainage Philosophy – Whole Scheme

- 1.4.1 The drainage design for the proposed Cogges Link Road is split into three catchment areas.
- Catchment Area 1 – Witan Way to the River Windrush (West Branch)
 - Catchment Area 2 – Between the over bridges on the River Windrush (East and West Branches)
 - Catchment Area 3 – East of River Windrush (East Branch)
- 1.4.2 It is currently proposed to drain the carriageway using a positive drainage system of kerbs and gullies.
- 1.4.3 Highway verges and cutting slopes will collect surface run off via a filter drain system placed at the back of the verge.
- 1.4.4 Cut off drains to intercept surface water run off from the adjacent fields will be provided. These will be in the form of either drainage ditches or filter drains. Ditches are the preferred option but need to be agreed with the Geotechnical

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Engineer. The cut off ditches could also provide an element of attenuation and retention with the inclusion of headwalls and weirs if necessary.

- 1.4.5 Water collected from the adjacent fields will be kept separate from the highway drainage and be piped across the road to be connected back into the existing hydrology as shown on Drawing No. 0834600/Doc/PA/CLR/09/04.

1.5 Consultation

- 1.5.1 A preliminary drainage report Dated 14 April 2003 was issued to the Environment Agency (EA) for comment on 29 May 2003.
- 1.5.2 A response from the EA was received on 6 August 2003. The requirements and comments have been incorporated into the redesign of the preliminary drainage and this report.
- 1.5.3 Further discussions took place with the EA and it was identified that the original drainage designs needed to be updated to incorporate the requirements of PPS25: Development and Flood Risk.
- 1.5.4 On the 21 January 2008, Nick Read at the EA stated that the preferred method of assessment should use FEH Rainfall Data. The assessment of the options for the drainage proposals had been previously carried out using the Wallingford Procedure. The chosen solution has been checked against the FEH rainfall Data which produced very similar results. This report has been prepared using the FEH calculations on the selected design.

2 Proposed Drainage Design

2.1 Catchment Area 1 – Witan Way to River Windrush (West Branch)

2.1.1 It is proposed to connect into the existing highway drainage network, utilising the existing highway drainage outfall.

2.1.2 Additional pollution interceptors will be provided if required.

2.1.3 Attenuation for this catchment area will be provided in the form of oversized pipes to store run off up to a 1 in 100 year event for the new carriageway area only. Detailed design of pipe sizing and control features will need to be issued to the Environment Agency for approval during the detailed design of the scheme.

2.2 Catchment Area 2 – Between the over bridges on the River Windrush (East and West Branches)

2.2.1 It is proposed to provide a swale at the base of the embankments. The carriageway will be drained into the swale via drain runs down the embankment. The swale will be designed to restrict the flow of water to less than 0.3 l/s during a 1 in 1 year storm to promote filtration and settlement. Storms of greater intensity will result in a greater flow. The detailed design of the swale profile, gradient and flow controls will be submitted for approval after completion of the remodelling of the Windrush Floodplain.

2.2.2 The detailed design of the swale will need to ensure that the swale is positioned such that it is not washed out in a 1 in 100 year event.

2.2.3 As this catchment is directly above the flood plain, greenfield runoff calculations will be the same as a storm event.

2.3 Catchment Area 3 – Incorporating the Storage Lagoon

2.3.1 Drawing no. 0834600/Doc/PA/CLR/09/03 shows the catchment areas used:

- Total Impervious Area = 3.46 hectares (verges and embankments included)
- This catchment will be drained into the balancing pond via outfalls adjacent to the carriageway

2.3.2 The catchment is the proposed highway between chainages 450 and 1950. It is proposed that runoff from the carriageway, footways, verges and some of the embankment slopes will be collected within the highway drainage network and discharged into the water course just south of the pumping station via a new surface water storage lagoon pond situated east of Stanton Harcourt Road between the A40 and the route of the proposed road.

2.4 Surface Water Run off from Cogges Hill

2.4.1 The agricultural land on Cogges Hill, east of the Cogges Estate falls westwards towards Cogges, existing surface run off is collected by ditches and then channelled through the housing estate via pipes and open ditches before entering the watercourse immediately to the west of Cogges and adjacent to the Thames Water Pumping Station.

2.4.2 It is proposed to intercept the surface water flow from the adjacent fields by way of ditches or filter drains at the top of embankments. The water will be directed through the ditches to the low point before being piped beneath the road to the existing outfall detailed on Drawing No. 0834600/Doc/PA/CLR/09/04. A licence would be required to enable a gravity connection to be installed and maintained across private lane between Cogges and the proposed Link Road.

2.5 Pipe Network Design

2.5.1 The pipe network has been designed for a 1 in 2 year event without surcharge and checked for a 1 in 30 year event without flooding.

2.5.2 Further checks have been carried out to determine the impact of a 1 in 100 year event. There is some minor flooding along the road, however this is not at a low point so will travel along the kerb before re-entering the drainage system further down the network. It has been necessary to design several of the pipe runs with oversized pipes to reduce the risk of exceedence during a 1 in 30 year event.

2.6 Storage Lagoon Design

2.6.1 A storage lagoon has been designed and is located within the area of land west of Stanton Harcourt Road enclosed between the A40 and the proposed link road.

2.6.2 The lagoon will be designed to prevent the pollutants from the highway run off discharging into the adjacent water course.

2.6.3 The ecological features of the lagoon have not been considered at this time but will be detailed as part of the detailed design process. The lagoon ponds will be designed to provide additional biodiversity resource. It is possible to provide an area of 'dead storage' below the invert of the outlet. As well as providing permanent habitat to encourage biodiversity it provides a large area of water to trap silt.

2.6.4 The invert of the lagoon is fixed by the adjacent outfall locations and levels. The proposed outfall is into the watercourse immediately west of the Cogges Estate at the location shown on Drawing Nos. 0834600/Doc/PA/CLR/09/03. The survey indicates an invert level of the watercourse at the outfall location as 77.60m AOD. It is obvious that the watercourse has silted up over time, the controlling level is the down stream invert level of 77.30m AOD at the culvert beneath the A40.

2.6.5 The watercourse will be cleaned out to provide a new invert level of 77.35m at the location of the outfall. Therefore an invert level of 77.7m AOD has been designed for the outlet from the lagoon.

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- 2.6.6 The lagoon has been designed with maximum storage level of 78.500m AOD. A freeboard of 0.5m will also be provided as a safety factor, giving a top of lagoon level of 79.000m.
- 2.6.7 The outlet pipes from the pond have been designed for a 1 in 1 year return event and will restrict outflow to less than has been agreed with the EA. The Overflow has then been sized and the invert determined within the limits of the agreed outflow for a 1 in 100 year event. A 30% increase in intensity has been included to take account of climate warming, as recommended in PPS25 table B2.

2.7 Design scenarios

- 2.7.1 The 'Micro Drainage – Windes' package has been used to design the drainage network and storage lagoon and to check against exceedence for 1 in 30 and 1 in 100 year events plus a 30% allowance on rainfall intensity for climate change.
- 2.7.2 The Oxfordshire County Council document 'The Drainage Design Manual' suggests that the design should be carried out using 100 % contribution from impermeable surfaces, paved surfaces, and 50% from permeable surfaces i.e. verges and embankments etc. In order to ensure that the storage Lagoon was not overloaded the design has allowed for 100% contribution from both permeable and impermeable surfaces.
- 2.7.3 Green field run of calculations have been calculated for a 1 in 1 year event and factored up for 1 in 100 year event. See appendix 4
- 2.7.4 For the catchment area of 3.46Ha, a greenfield runoff rate for a 1 in 1 year event is 14.18 l/s, for 1 in 100 year event it is 46.04 l/s.

2.8 Global Variables used from the Flood Estimation Handbook

| | |
|----------|--------|
| C (1km) | -0.023 |
| D1 (1km) | 0.320 |
| D2 (1km) | 0.308 |
| D3(1km) | 0.308 |
| E (1km) | 0.284 |
| F (1km) | 2.414 |

2.9 Assumptions

- 2.9.1 Designed rainfall intensities have been increased by 30% in accordance with the recommended allowance for climate change from PPS25 table B2 for years 2055 to 2085.
- 2.9.2 No allowance has been made for the storage capabilities within the cut off ditches or filter drains.
- 2.9.3 No allowance has been made for infiltration.

Design of out fall from the lagoon

2.9.4 The design of the outflow from the lagoon has been calculated in accordance with the Environment Agency - Thames Region document, 'Control of Runoff from New Developments, Interim Regional Guidance' dated 30 September 1997 and the methodology set out in the ADAS publication 'The Design of Field Drainage Pipe Systems' reference book 345.

2.10 Storage design – determination of outlet control requirements

2.10.1 For the purposes of modelling the storage lagoon simple pipe outflow devices have been used. Other control mechanisms could be considered as part of the consultation and approval process with the EA.

2.10.2 The design of the main outlet control feature has been determined using a one-year storm. Inflows greater than the outflow will be attenuated within the storage lagoon.

2.10.3 Once the outlet device has been determined the storage volume has then been designed for a 1 in 100 year event + 30% increase in intensity for climate change. The overflow control has then been designed to limit total outflow to the allowance for the catchment area as previously agreed with the EA. Inflows greater than the outflow will be attenuated within the storage lagoon.

2.10.4 During the design process, various alternatives of outlet and overflow have been assessed. The proposed design of the control device for the pond will be a 100mm dia. outlet with an invert of 77.700m along with a 150mm dia. overflow pipe with an invert of 78.500m.

2.10.5 No allowance has been made for any storage within existing ditches as part of the highway design.

2.11 Control of Runoff

2.11.1 Catchment 1 – It is intended to utilise the existing highway drainage system in Witan Way. Pollution control would be provided by way of a new bypass pollution interceptor for the immediate roundabout and link road only.

2.11.2 Catchment 2 – will use swales as the means to diffuse pollution prior to outfalling into the Windrush.

2.11.3 Catchment 3 – The first 10mm of runoff from Cogges Link Road will be collected in the storage lagoon. It is proposed to have wet areas/dead storage within the storage lagoon utilising reed beds to assist in the filtration of pollutants prior to discharge into the adjacent watercourses.

2.11.4 Runoff from the agricultural land east of the link road will be controlled by collection in cut off ditches and filter drains, no treatment is required.

2.12 Assessment of Pollution Risk

- 2.12.1 An assessment of potential risk and impacts from pollution has been carried out as advised in the Highways Agency - Design Manual for Roads and Bridges – HA216/06 Road Drainage and the Water Environment, giving guidance on the assessment and management of the impacts a road may have on the water environment. (See Appendices 9-10)
- 2.12.2 These include possible impacts on the quality of water bodies and on the existing hydrology of the catchments through which they pass.
- 2.12.3 Pollution from road drainage can arise from a variety of sources, these include accidents, general vehicle and road degradation, incomplete fuel combustion, small oil or fuel leaks and atmospheric deposition. Road runoff may also contain runoff from adjacent properties, verges and agricultural land.

Site Parameters

- 2.12.4 A desktop study of the existing water quality is included in the report in Volume 2B Geology and Contamination,
- 2.12.5 The water quality of the River Windrush has been assessed as a RE1 watercourse by the Environment Agency.
- 2.12.6 The Cogges Link Road would not impinge on any Aquifer Protection Zone, although there are water abstraction points within 2000m of the proposed road, the closest of these which is used for laundry use is approximately 600 metres away

Method A – Simple Assessment of Pollution Impacts from Routine Runoff

- 2.12.7 This method is a simple assessment method for determining whether the routine runoff is likely to have an impact on receiving watercourses. If it shows that an impact is possible, further assessment using Method B will be required.
- 2.12.8 The process of the assessment is detailed in Appendix 9.
- 2.12.9 The conclusion of this assessment is that no further assessment is required, as the dilution exceeds the minimum requirement for impacts from routine runoff on a RE1 Watercourse.

Method B – Detailed Assessment of Pollution Impact from Routine Runoff

- 2.12.10 The result of assessment method A is that the more detailed assessment B is not required.

Method C – Assessment of Pollution Impacts from Routine Runoff on Groundwaters

- 2.12.11 This assessment is not required as the scheme proposals do not discharge routine runoff to the ground.

Method D – Assessment of Pollution Impacts from Accidental Spillages

- 2.12.12 This method provides an indication of the risk of an accidental spillage causing a pollution impact on receiving water bodies.
- 2.12.13 The process is detailed in Appendix 10.
- 2.12.14 This risk is defined as the probability that there will be an accidental spillage of pollutant and that the pollutant will reach and impact on the water body to such an extent that either a category 1 or 2 incident (a serious pollution incident occurs).
- 2.12.15 The assessment detailed in Appendix 10 determines that the risk of accidental spillage along the Cogges Link Road is less than the acceptable risk of 1%, therefore no mitigation is required as a result of this assessment.

2.13 Mitigation of Impacts

- 2.13.1 A general arrangement for managing pollution from surface water runoff would be provided by the use of trapped gullies to collect silts and separate oils. Catchpits will be provided at regular intervals as a further mechanism to collect silts.
- 2.13.2 In this instance mitigation in the form of pollution interceptors is not required.
- 2.13.3 The proposed storage lagoon will allow silts to settle out prior to discharge into the adjacent water course. Planting of reeds and grasses within the lagoon will further aid the separation and removal of pollutants from surface water runoff.
- 2.13.4 Placing a penstock valve on the outfall of the lagoon would enable the lagoon to be isolated for maintenance and removal of accidental spillage.

2.14 Flood Risk

- 2.14.1 The DMRB HA 216/06 'Road Drainage and the Water Environment' also assesses flood risk, this has been dealt with in a separate report (B0834600/Doc/PA/CLR/08), modelling the impact of climate change on the River Windrush.
- 2.14.2 As the report concludes that the Cogges Link Road would not impact on the recently modelled 1 in 100 year flood plain, including 30% allowance for increase due to climate change, no mitigation would be required.

3 Summary

3.1 Summary of Results

3.1.1 A table summarising the results is shown in Appendix 1.

3.2 Conclusions

3.2.1 The proposed lagoon will accommodate a 1 in 100 year event in both summer and winter conditions + a 30% increase in intensity for climate change.

3.3 Design Data provided for Audit Check.

Appendix 1: Storage Lagoon Results.

Appendix 2: Drawing No. 0834600/Doc/PA/CLR/09/01 – Storage Lagoon preliminary design layout.

Appendix 3: Typical Sections.

Appendix 4: Green Field Runoff Calculations.

Appendix 5: Micro Drainage design output (Networks and Storage).

Appendix 6: Drawing No. 0834600/Doc/PA/CLR/09/02 - Long section at scales 1:2500 Horizontal and 1:250 Vertical.

Appendix 7: Drawing Nos. 0834600/Doc/PA/CLR/09/03 + 04 – Preliminary Drainage Layout.

Appendix 8: Assessment of Pollution Impacts from routine runoff.

Appendix 9: Assessment of Pollution Impacts from accidental spillage.

Appendix 1

Storage Lagoon Results

Cogges Link Road

| Catchment | Calculation method | Area (Ha) | Impermeability Criteria CV factor | Adjusted area (Ha) | Proposed simple outflow control pipe dia (mm) | Proposed outflow invert level (mm) | Proposed simple overflow control pipe dia (mm) | Designed overflow invert level (mm) | Acceptable overflow invert level (mm) | Calculated permitted outflow (l/s) | Maximum lagoon design outflow | Maximum flood level 1 year event (m) | Calculated permitted outflow (l/s) | Maximum lagoon design outflow | Maximum flood level 100 year event (m) | Acceptability |
|------------------------------|--------------------|-----------|--------------------------------------|--------------------|---|------------------------------------|--|-------------------------------------|---------------------------------------|------------------------------------|-------------------------------|--------------------------------------|------------------------------------|-------------------------------|--|---------------|
| | | | | | | | | | | 1 year | | | 100 year | | | |
| Carriageway/verge/embankment | Wallingford / FEH | 3.46 | Cv 0.79 | 3.46 | 100 | 77.700 | 150 | 78.500 | 78.500 | 14.18 | 10.4 | 78.000 | 46.04 | 18.0 | 78.493 | Ok |

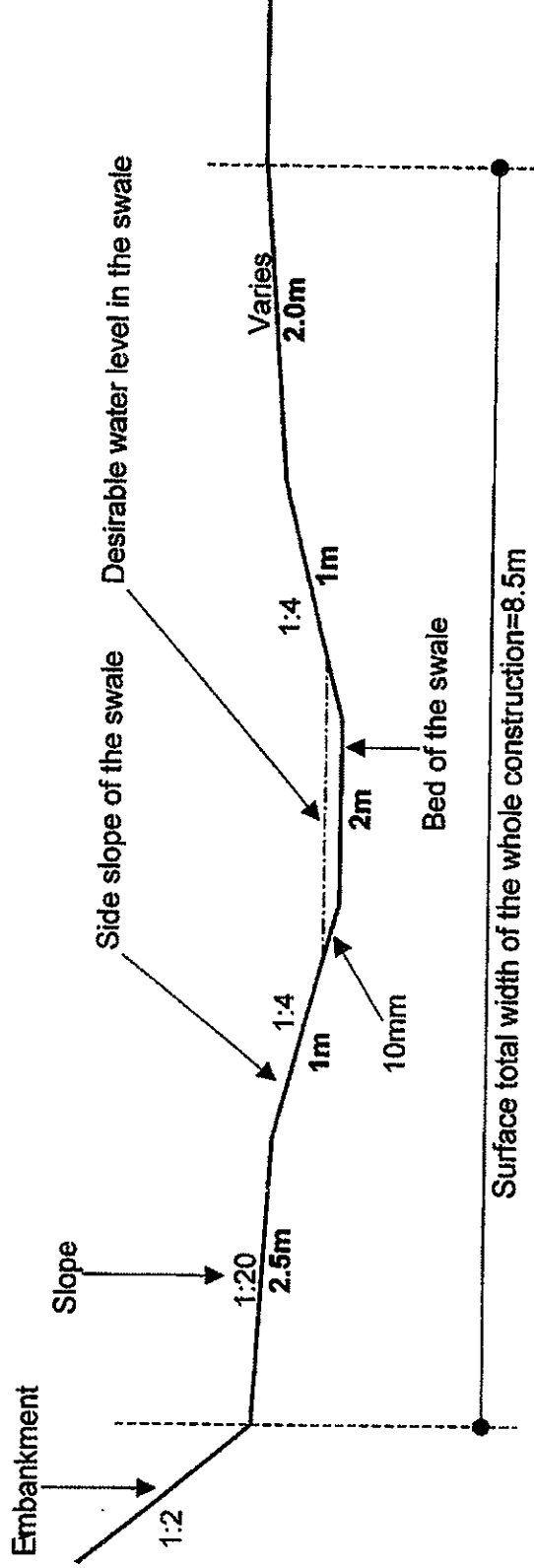
Appendix 2

Storage Lagoon Draft Design Layout Drawing No 0834600/Doc/PA/CLR/09/01

Appendix 3

Typical Sections

Appendix 3 Typical Sections – Proposed Cross Section of Swale



Appendix 4

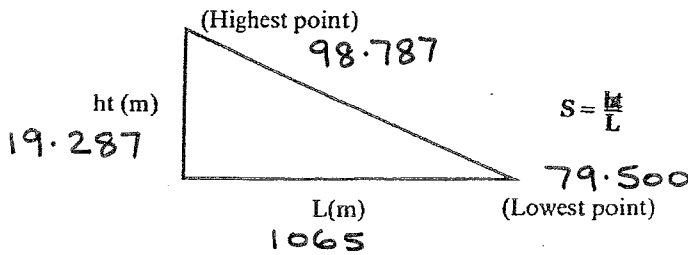
GreenField Runoff Calculations

Witney Cogges Link Road
Drainage Design Report

Determination of permitted outflow
Catchment Area 3

Determination of design flow

1. Locate a suitable map of the area and determine the catchment area A in hectares.
2. Determine the maximum length of catchment L in metres
3. Determine the average slope of the catchment S



4. Determine the catchment of characteristic C
 $C = 0.0001 \frac{L}{S}$
5. Determine the dominant crop type
Grass
Arable
Horticulture
6. Determine the average annual rainfall AAR in mm from
Appendix 1 Wallingford procedure Vol 3 Map.

7. Determine the soil type factor S_T

| Permeability Class | Range (m/day) | Ranges for Soil Textures | S_T |
|--------------------|---------------|--------------------------|-------|
| — | — | Peat (Upland) | 1.3 |
| Very slow | <0.01- 0.1 | C | 1.0 |
| Slow - Mod | 0.1 - 0.3 | CL, Zyc | 0.8 |
| Moderate | 0.3 - 1.0 | SL, Zyc | 0.5 |
| Mod - Rapid | 1.0 -10.0 | CL, Zyc | 0.1 |
| Very Rapid | >10 | (low) | 0.1 |

Note: for complex areas interpolation between soil types may be desirable

8. At Appendix 6 enter the graph at C. Move across (left) to crop type, down to average annual rainfall (AAR), across (right) to the standard line and up to F number.
9. Peak Flood Flow $Q_0 = S_T \times F \times A$
10. For each per cent of paved areas add 1% to the derived Peak Flood Flow. (Where paved area exceeds 10% of the catchment this method is not appropriate).

| | |
|-------------------|-------------|
| A(ha) | 2.936 |
| L(m) | 1065 |
| S | 0.018 |
| C(m) | 5.917 |
| | G * H |
| AAR (mm) | 700 |
| S_T | 1.0 |
| F | 4.1 |
| Q_0 (l/s) | 12.03 |
| Total Q_0 (l/s) | 12.03 |

AREA East
of Stanton
Harcourt Rd

1 yr return.

Adjust for a 100 yr return

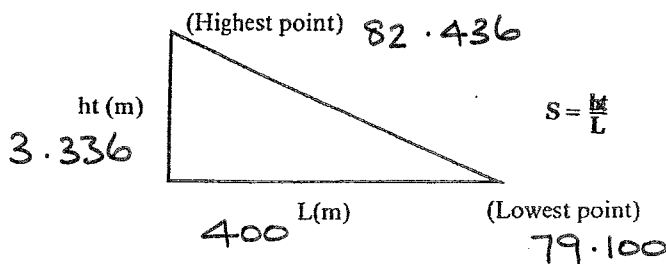
$12.03 \times 3.19 = 37.29$ 100yr

Witney Cogges Link Road
Drainage Design Report

Determination of permitted outflow
Catchment Area 3

Determination of design flow

1. Locate a suitable map of the area and determine the catchment area A in hectares.
2. Determine the maximum length of catchment L in metres
3. Determine the average slope of the catchment S



4. Determine the catchment of characteristic C
 $C = 0.0001 \frac{L}{S}$
5. Determine the dominant crop type
Grass
Arable
Horticulture
6. Determine the average annual rainfall AAR in mm from
Appendix-1 Wallingford procedure Vol 3 Map.
7. Determine the soil type factor S_T

| Permeability Class | Range (m/day) | Ranges for Soil Textures | S_T |
|--------------------|---------------|--------------------------|-------|
| — | — | Peat (Upland) | 1.3 |
| Very slow | <0.01- 0.1 | C | 1.0 |
| Slow - Mod | 0.1 - 0.3 | CL, SC, ZyC | 0.8 |
| Moderate | 0.3 - 1.0 | CL, SC, ZyC | 0.5 |
| Mod - Rapid | 1.0 - 10.0 | Pt, S, SL, ZyCL | 0.1 |
| Very Rapid | >10 | (low) | 0.1 |

Note: for complex areas interpolation between soil types may be desirable

8. At Appendix 6 enter the graph at C. Move across (left) to crop type, down to average annual rainfall (AAR), across (right) to the standard line and up to F number.
9. Peak Flood Flow $Q_0 = S_T \times F \times A$
10. For each per cent of paved areas add 1% to the derived Peak Flood Flow. (Where paved area exceeds 10% of the catchment this method is not appropriate).

| | |
|-------------------|--------|
| A(ha) | 0.524 |
| L(m) | 400 |
| S | 0.0084 |
| C(m) | 4.762 |
| | |
| AAR (mm) | 700 |
| S_T | 1.0 |
| F | 4.5 |
| Q_0 (l/s) | 2.15 |
| Total Q_0 (l/s) | 2.15 |

Area West
of Stanton
harcourt Rd.

Adjust for a 100 yr return

$2.15 \times 3.19 = 6.85$ 100yr

1 yr return.

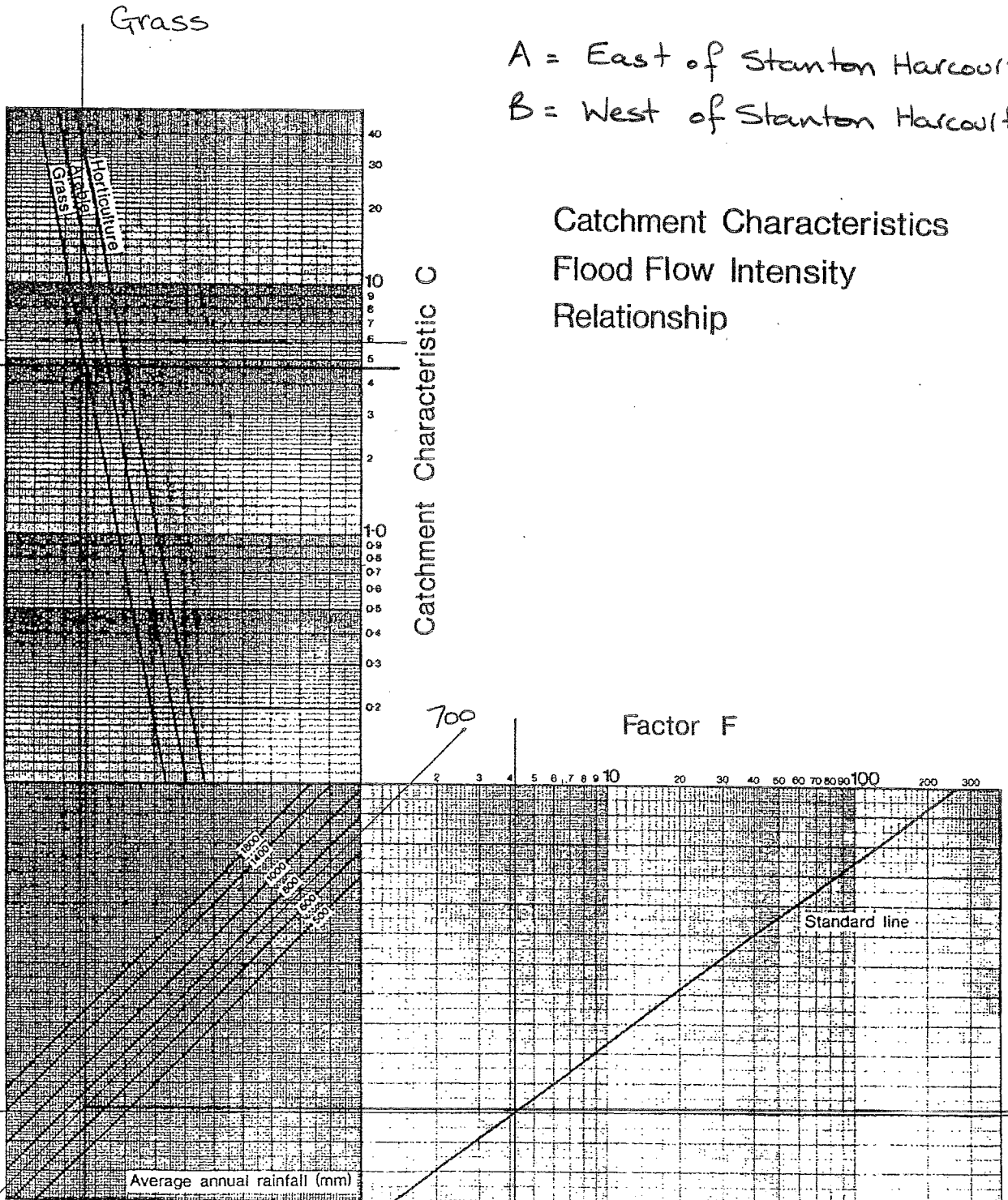
Appendix 6

A = East of Stanton Harcourt Rd
B = West of Stanton Harcourt Rd.

Catchment Characteristics
Flood Flow Intensity
Relationship

(A) 5.917

(B) 4.762

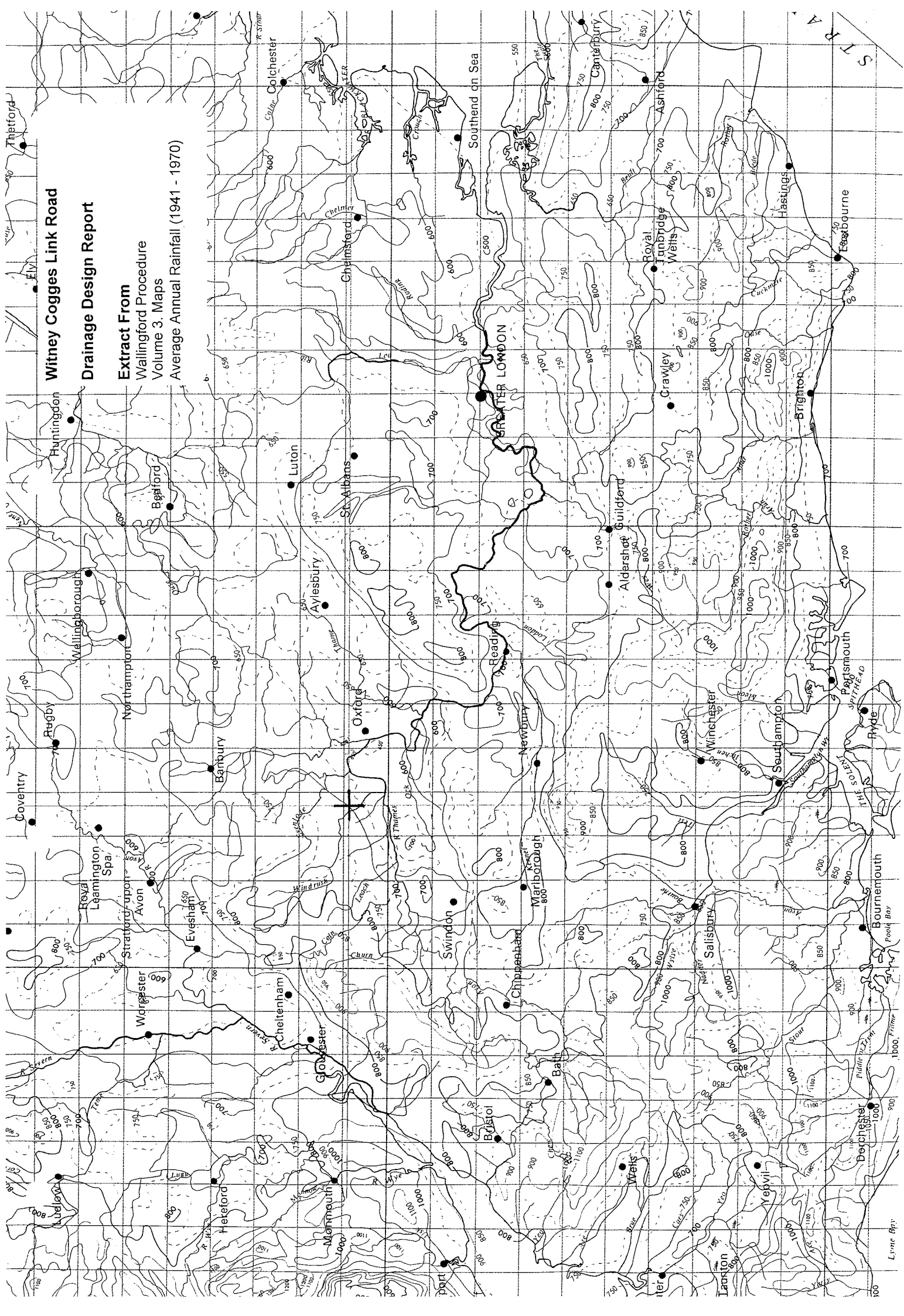


$F = 4.1$ (A)

$F = 4.5$ (B)

Witney Cogges Link Road Drainage Design Report

Extract From
Wallingford Procedure
Volume 3. Maps
Average Annual Rainfall (1941 - 1970)



Appendix 5

Micro Drainage Design Outputs (Networks and Storage) Carriageway and Verges within Highway Boundaries

STORM SEWER DESIGN by the Modified Rational Method

Global Variables

Pipe Size File c:\WinDes\STANDARD.PIP Manhole Size File c:\WinDes\STANDARD.MHS

FEH Rainfall Model

| | | | |
|-----------------------------|-----------|--------------------------------------|-------|
| Return Period (years) | 2 | Add Flow / Climate Change (%) | 0 |
| Site Location | (Unknown) | Minimum Backdrop Height (m) | 0.200 |
| C (1km) | -0.023 | Maximum Backdrop Height (m) | 0.000 |
| D1 (1km) | 0.320 | Min Cover Depth for Optimisation (m) | 0.000 |
| D2 (1km) | 0.308 | Min Vel for Auto Design Only (m/s) | 0.79 |
| D3 (1km) | 0.308 | Min Slope for Optimisation (1:X) | 500 |
| E (1km) | 0.284 | Minimum Outfall Invert (m) | 0.000 |
| F (1km) | 2.414 | Ground Level at Outfall (m) | 0.000 |
| Maximum Rainfall (mm/hr) | 75 | Outfall Manhole Name | |
| Foul Sewage (l/s/ha) | 0.00 | Outfall Manhole Dia/Length (mm) | 0 |
| O'flow Setting (*Foul only) | 0 | Outfall Manhole Width (mm) | 0 |
| Volumetric Runoff Coeff. | 0.79 | | |

Designed with Level Soffits

Network Design Table

| PN | Length (m) | Fall (m) | Slope (1:X) | Area (ha) | T.E. (mins) | DWF (l/s) | k (mm) | HYD SECT | DIA (mm) |
|-------|------------|----------|-------------|-----------|-------------|-----------|--------|----------|----------|
| 1.000 | 70.00 | 0.252 | 278.3 | 0.245 | 4.00 | 0.0 | 2.000 | o | 300 |
| 1.001 | 80.00 | 0.235 | 340.4 | 0.286 | 0.00 | 0.0 | 2.000 | o | 375 |
| 1.002 | 60.00 | 0.127 | 472.4 | 0.130 | 0.00 | 0.0 | 2.000 | o | 450 |
| 1.003 | 18.00 | 0.174 | 103.2 | 0.000 | 0.00 | 0.0 | 0.150 | o | 450 |
| 2.000 | 32.00 | 0.210 | 152.4 | 0.026 | 4.00 | 0.0 | 2.000 | o | 225 |
| 2.001 | 72.00 | 0.539 | 133.6 | 0.066 | 0.00 | 0.0 | 2.000 | o | 225 |
| 1.004 | 73.00 | 0.500 | 146.0 | 0.157 | 0.00 | 0.0 | 2.000 | o | 450 |
| 1.005 | 70.00 | 1.300 | 53.8 | 0.165 | 0.00 | 0.0 | 2.000 | o | 450 |
| 1.006 | 70.00 | 1.100 | 63.6 | 0.174 | 0.00 | 0.0 | 2.000 | o | 450 |
| 1.007 | 75.00 | 2.300 | 32.6 | 0.163 | 0.00 | 0.0 | 2.000 | o | 450 |
| 1.008 | 65.00 | 3.043 | 21.4 | 0.144 | 0.00 | 0.0 | 2.000 | o | 450 |
| 1.009 | 60.00 | 2.000 | 30.0 | 0.127 | 0.00 | 0.0 | 2.000 | o | 450 |
| 1.010 | 65.00 | 1.200 | 54.2 | 0.135 | 0.00 | 0.0 | 2.000 | o | 450 |
| 1.011 | 70.00 | 0.750 | 93.3 | 0.143 | 0.00 | 0.0 | 2.000 | o | 450 |
| 1.012 | 65.00 | 0.750 | 86.7 | 0.159 | 0.00 | 0.0 | 2.000 | o | 450 |

Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | E.Area (ha) | E.DWF (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | CAP (l/s) | Flow (l/s) |
|-------|--------------|-------------|-----------|-------------|-------------|------------|----------------|-----------|-----------|------------|
| 1.000 | 72.1 | 5.5 | 95.000 | 0.245 | 0.0 | 0.0 | 0.0 | 0.79 | 56.1 | 50.4 |
| 1.001 | 60.3 | 7.1 | 94.673 | 0.531 | 0.0 | 0.0 | 0.0 | 0.83 | 91.8 | 91.3 |
| 1.002 | 53.8 | 8.3 | 94.363 | 0.661 | 0.0 | 0.0 | 0.0 | 0.79 | 126.4 | 101.4 |
| 1.003 | 53.2 | 8.5 | 94.236 | 0.661 | 0.0 | 0.0 | 0.0 | 2.32 | 368.6 | 101.4 |
| 2.000 | 75.0 | 4.6 | 95.036 | 0.026 | 0.0 | 0.0 | 0.0 | 0.89 | 35.3 | 5.6 |
| 2.001 | 68.6 | 5.9 | 94.826 | 0.092 | 0.0 | 0.0 | 0.0 | 0.95 | 37.7 | 18.0 |
| 1.004 | 49.8 | 9.3 | 94.062 | 0.910 | 0.0 | 0.0 | 0.0 | 1.43 | 227.8 | 129.2 |
| 1.005 | 48.0 | 9.8 | 93.562 | 1.075 | 0.0 | 0.0 | 0.0 | 2.36 | 375.5 | 147.3 |
| 1.006 | 46.3 | 10.3 | 92.262 | 1.249 | 0.0 | 0.0 | 0.0 | 2.17 | 345.4 | 164.9 |
| 1.007 | 45.0 | 10.8 | 91.162 | 1.412 | 0.0 | 0.0 | 0.0 | 3.04 | 482.7 | 181.4 |
| 1.008 | 44.2 | 11.0 | 88.862 | 1.556 | 0.0 | 0.0 | 0.0 | 3.75 | 596.6 | 196.2 |
| 1.009 | 43.3 | 11.4 | 85.819 | 1.683 | 0.0 | 0.0 | 0.0 | 3.16 | 503.3 | 208.1 |
| 1.010 | 42.2 | 11.8 | 83.819 | 1.818 | 0.0 | 0.0 | 0.0 | 2.35 | 374.4 | 218.7 |
| 1.011 | 40.6 | 12.5 | 82.619 | 1.961 | 0.0 | 0.0 | 0.0 | 1.79 | 285.1 | 227.2 |
| 1.012 | 39.3 | 13.1 | 81.869 | 2.120 | 0.0 | 0.0 | 0.0 | 1.86 | 295.9 | 238.0 |

Network Design Table

| PN | Length (m) | Fall (m) | Slope (1:X) | Area (ha) | T.E. (mins) | DWF (l/s) | k (mm) | HYD SECT | DIA (mm) |
|-------|------------|----------|-------------|-----------|-------------|-----------|--------|----------|----------|
| 1.013 | 75.00 | 0.850 | 88.2 | 0.182 | 0.00 | 0.0 | 2.000 | o | 450 |
| 1.014 | 75.00 | 0.600 | 125.0 | 0.191 | 0.00 | 0.0 | 2.000 | o | 525 |
| 3.000 | 75.00 | 0.940 | 79.8 | 0.122 | 4.00 | 0.0 | 2.000 | o | 225 |
| 3.001 | 76.00 | 1.150 | 66.1 | 0.139 | 0.00 | 0.0 | 2.000 | o | 225 |
| 3.002 | 73.00 | 1.500 | 48.7 | 0.144 | 0.00 | 0.0 | 2.000 | o | 300 |
| 3.003 | 12.00 | 0.100 | 120.0 | 0.000 | 0.00 | 0.0 | 0.150 | o | 300 |
| 1.015 | 100.00 | 0.300 | 333.3 | 0.074 | 0.00 | 0.0 | 2.000 | o | 600 |
| 1.016 | 90.00 | 0.250 | 360.0 | 0.087 | 0.00 | 0.0 | 2.000 | o | 600 |
| 4.000 | 27.00 | 0.234 | 115.4 | 0.042 | 4.00 | 0.0 | 0.150 | o | 225 |
| 4.001 | 81.00 | 1.500 | 54.0 | 0.062 | 0.00 | 0.0 | 0.150 | o | 225 |
| 5.000 | 27.00 | 0.100 | 270.0 | 0.021 | 4.00 | 0.0 | 0.150 | o | 225 |
| 5.001 | 82.00 | 0.964 | 85.1 | 0.028 | 0.00 | 0.0 | 0.150 | o | 225 |
| 5.002 | 13.00 | 0.619 | 21.0 | 0.000 | 0.00 | 0.0 | 0.150 | o | 225 |
| 4.002 | 80.00 | 0.160 | 500.0 | 0.091 | 0.00 | 0.0 | 0.150 | o | 300 |
| 4.003 | 80.00 | 0.500 | 160.0 | 0.091 | 0.00 | 0.0 | 0.150 | o | 300 |
| 4.004 | 80.00 | 0.160 | 500.0 | 0.091 | 0.00 | 0.0 | 0.150 | o | 375 |
| 4.005 | 80.00 | 0.174 | 459.8 | 0.000 | 0.00 | 0.0 | 0.150 | o | 375 |
| 1.017 | 22.00 | 0.248 | 88.7 | 0.000 | 0.00 | 0.0 | 0.150 | o | 600 |

Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | E.Area (ha) | E.DWF (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | CAP (l/s) | Flow (l/s) |
|-------|--------------|-------------|-----------|-------------|-------------|------------|----------------|-----------|-----------|------------|
| 1.013 | 38.0 | 13.7 | 81.119 | 2.302 | 0.0 | 0.0 | 0.0 | 1.84 | 293.2 | 249.5 |
| 1.014 | 36.6 | 14.5 | 80.194 | 2.493 | 0.0 | 0.0 | 0.0 | 1.71 | 370.4 | 260.6 |
| 3.000 | 75.0 | 5.0 | 82.563 | 0.122 | 0.0 | 0.0 | 0.0 | 1.23 | 48.8 | 26.1 |
| 3.001 | 67.9 | 6.0 | 81.623 | 0.261 | 0.0 | 0.0 | 0.0 | 1.35 | 53.7 | 50.6 |
| 3.002 | 63.3 | 6.6 | 80.398 | 0.405 | 0.0 | 0.0 | 0.0 | 1.90 | 134.6 | 73.1 |
| 3.003 | 62.5 | 6.7 | 78.898 | 0.405 | 0.0 | 0.0 | 0.0 | 1.67 | 117.8 | 73.1 |
| 1.015 | 34.3 | 15.9 | 78.498 | 2.972 | 0.0 | 0.0 | 0.0 | 1.14 | 322.5 | 290.5 |
| 1.016 | 32.4 | 17.3 | 78.198 | 3.059 | 0.0 | 0.0 | 0.0 | 1.10 | 310.3 | 290.5 |
| 4.000 | 75.0 | 4.3 | 81.051 | 0.042 | 0.0 | 0.0 | 0.0 | 1.42 | 56.4 | 9.0 |
| 4.001 | 75.0 | 5.0 | 80.817 | 0.104 | 0.0 | 0.0 | 0.0 | 2.09 | 83.2 | 22.3 |
| 5.000 | 75.0 | 4.5 | 81.000 | 0.021 | 0.0 | 0.0 | 0.0 | 0.91 | 36.3 | 4.5 |
| 5.001 | 73.5 | 5.3 | 80.900 | 0.049 | 0.0 | 0.0 | 0.0 | 1.66 | 65.9 | 10.3 |
| 5.002 | 72.9 | 5.4 | 79.936 | 0.049 | 0.0 | 0.0 | 0.0 | 3.38 | 134.5 | 10.3 |
| 4.002 | 60.4 | 7.1 | 79.242 | 0.244 | 0.0 | 0.0 | 0.0 | 0.80 | 56.3 | 42.0 |
| 4.003 | 55.4 | 8.0 | 79.082 | 0.335 | 0.0 | 0.0 | 0.0 | 1.44 | 101.6 | 53.0 |
| 4.004 | 49.3 | 9.4 | 78.507 | 0.426 | 0.0 | 0.0 | 0.0 | 0.92 | 101.5 | 59.9 |
| 4.005 | 44.8 | 10.8 | 78.347 | 0.426 | 0.0 | 0.0 | 0.0 | 0.96 | 106.0 | 59.9 |
| 1.017 | 32.2 | 17.4 | 77.948 | 3.485 | 0.0 | 0.0 | 0.0 | 2.99 | 845.0 | 320.1 |

Time Area Diagram

| Time From (mins) | Time To (mins) | Area (ha) |
|---------------------|-------------------|--------------|
| 0 | 4 | 0.126 |
| 4 | 8 | 1.449 |
| 8 | 12 | 1.211 |
| 12 | 16 | 0.613 |
| 16 | 20 | 0.086 |

Total Area Contributing (ha) = 3.485

Total Pipe Volume (m³) = 266.061

Summary of Results for 1 year Return Period (+30%)

| Storm Duration (mins) | Maximum Control (l/s) | Maximum Overflow (l/s) | Maximum Outflow (l/s) | Maximum Water Level (m OD) | Maximum Depth (m) | Overflow Volume (m³) | Maximum Volume (m³) | Status |
|-----------------------|-----------------------|------------------------|-----------------------|----------------------------|-------------------|----------------------|---------------------|--------|
| 15 Summer | 4.2 | 0.0 | 4.2 | 77.8068 | 0.1068 | 0.0 | 253.2 | 0 K |
| 30 Summer | 5.7 | 0.0 | 5.7 | 77.8313 | 0.1313 | 0.0 | 313.8 | 0 K |
| 60 Summer | 6.9 | 0.0 | 6.9 | 77.8602 | 0.1602 | 0.0 | 386.0 | 0 K |
| 120 Summer | 7.9 | 0.0 | 7.9 | 77.8933 | 0.1932 | 0.0 | 469.2 | 0 K |
| 180 Summer | 8.4 | 0.0 | 8.4 | 77.9133 | 0.2132 | 0.0 | 520.5 | 0 K |
| 240 Summer | 8.8 | 0.0 | 8.8 | 77.9273 | 0.2272 | 0.0 | 556.4 | 0 K |
| 360 Summer | 9.2 | 0.0 | 9.2 | 77.9452 | 0.2452 | 0.0 | 602.7 | 0 K |
| 480 Summer | 9.5 | 0.0 | 9.5 | 77.9557 | 0.2557 | 0.0 | 629.8 | 0 K |
| 600 Summer | 9.6 | 0.0 | 9.6 | 77.9632 | 0.2632 | 0.0 | 650.2 | 0 K |
| 720 Summer | 9.8 | 0.0 | 9.8 | 77.9697 | 0.2697 | 0.0 | 666.7 | 0 K |
| 960 Summer | 10.0 | 0.0 | 10.0 | 77.9782 | 0.2782 | 0.0 | 688.6 | 0 K |
| 1440 Summer | 10.2 | 0.0 | 10.2 | 77.9867 | 0.2867 | 0.0 | 711.4 | 0 K |
| 2160 Summer | 10.2 | 0.0 | 10.2 | 77.9888 | 0.2887 | 0.0 | 717.0 | 0 K |
| 2880 Summer | 10.1 | 0.0 | 10.1 | 77.9847 | 0.2847 | 0.0 | 706.6 | 0 K |
| 4320 Summer | 9.8 | 0.0 | 9.8 | 77.9707 | 0.2707 | 0.0 | 668.9 | 0 K |
| 5760 Summer | 9.4 | 0.0 | 9.4 | 77.9543 | 0.2542 | 0.0 | 626.1 | 0 K |
| 7200 Summer | 9.1 | 0.0 | 9.1 | 77.9387 | 0.2387 | 0.0 | 585.4 | 0 K |
| 8640 Summer | 8.7 | 0.0 | 8.7 | 77.9243 | 0.2242 | 0.0 | 548.7 | 0 K |
| 10080 Summer | 8.4 | 0.0 | 8.4 | 77.9118 | 0.2118 | 0.0 | 515.9 | 0 K |
| 15 Winter | 4.5 | 0.0 | 4.5 | 77.8133 | 0.1133 | 0.0 | 269.2 | 0 K |
| 30 Winter | 6.1 | 0.0 | 6.1 | 77.8393 | 0.1393 | 0.0 | 333.6 | 0 K |
| 60 Winter | 7.2 | 0.0 | 7.2 | 77.8703 | 0.1702 | 0.0 | 410.9 | 0 K |
| 120 Winter | 8.2 | 0.0 | 8.2 | 77.9058 | 0.2057 | 0.0 | 500.1 | 0 K |
| 180 Winter | 8.8 | 0.0 | 8.8 | 77.9273 | 0.2272 | 0.0 | 555.5 | 0 K |
| 240 Winter | 9.2 | 0.0 | 9.2 | 77.9423 | 0.2422 | 0.0 | 594.4 | 0 K |
| 360 Winter | 9.6 | 0.0 | 9.6 | 77.9618 | 0.2617 | 0.0 | 645.4 | 0 K |
| 480 Winter | 9.9 | 0.0 | 9.9 | 77.9732 | 0.2732 | 0.0 | 676.2 | 0 K |
| 600 Winter | 10.0 | 0.0 | 10.0 | 77.9807 | 0.2807 | 0.0 | 695.3 | 0 K |
| 720 Winter | 10.1 | 0.0 | 10.1 | 77.9857 | 0.2857 | 0.0 | 708.9 | 0 K |

| Storm Duration (mins) | Rain (mm/hr) | Time-Peak (mins) |
|-----------------------|--------------|------------------|
| 15 Summer | 37.30 | 31 |
| 30 Summer | 23.28 | 44 |
| 60 Summer | 14.53 | 72 |
| 120 Summer | 9.07 | 130 |
| 180 Summer | 6.88 | 188 |
| 240 Summer | 5.66 | 248 |
| 360 Summer | 4.30 | 364 |
| 480 Summer | 3.53 | 460 |
| 600 Summer | 3.04 | 512 |
| 720 Summer | 2.68 | 574 |
| 960 Summer | 2.20 | 700 |
| 1440 Summer | 1.66 | 976 |
| 2160 Summer | 1.25 | 1388 |
| 2880 Summer | 1.03 | 1796 |
| 4320 Summer | 0.78 | 2600 |
| 5760 Summer | 0.64 | 3352 |
| 7200 Summer | 0.55 | 4112 |
| 8640 Summer | 0.48 | 4848 |
| 10080 Summer | 0.43 | 5560 |
| 15 Winter | 37.30 | 31 |
| 30 Winter | 23.28 | 44 |
| 60 Winter | 14.53 | 72 |
| 120 Winter | 9.07 | 128 |
| 180 Winter | 6.88 | 186 |
| 240 Winter | 5.66 | 242 |
| 360 Winter | 4.30 | 356 |
| 480 Winter | 3.53 | 464 |
| 600 Winter | 3.04 | 566 |
| 720 Winter | 2.68 | 592 |

Summary of Results for 1 year Return Period (+30%)

| Storm Duration (mins) | Maximum Control (l/s) | Maximum Overflow (l/s) | Maximum Outflow (l/s) | Maximum Water Level (m OD) | Maximum Depth (m) | Overflow Volume (m ³) | Maximum Volume (m ³) | Status |
|-----------------------|-----------------------|------------------------|-----------------------|----------------------------|-------------------|-----------------------------------|----------------------------------|------------|
| 960 Winter | 10.3 | 0.0 | 10.3 | 77.9932 | 0.2932 | 0.0 | 728.5 | 0 K |
| 1440 Winter | 10.4 | 0.0 | 10.4 | 77.9977 | 0.2977 | 0.0 | 741.2 | 0 K |
| 2160 Winter | 10.3 | 0.0 | 10.3 | 77.9932 | 0.2932 | 0.0 | 728.6 | 0 K |
| 2880 Winter | 10.1 | 0.0 | 10.1 | 77.9827 | 0.2827 | 0.0 | 701.0 | 0 K |
| 4320 Winter | 9.5 | 0.0 | 9.5 | 77.9578 | 0.2577 | 0.0 | 635.0 | 0 K |
| 5760 Winter | 8.9 | 0.0 | 8.9 | 77.9332 | 0.2332 | 0.0 | 571.5 | 0 K |
| 7200 Winter | 8.4 | 0.0 | 8.4 | 77.9117 | 0.2117 | 0.0 | 516.1 | 0 K |
| 8640 Winter | 7.9 | 0.0 | 7.9 | 77.8933 | 0.1933 | 0.0 | 469.3 | 0 K |
| 10080 Winter | 7.5 | 0.0 | 7.5 | 77.8778 | 0.1778 | 0.0 | 430.1 | 0 K |

| Storm Duration (mins) | Rain (mm/hr) | Time-Peak (mins) |
|-----------------------|--------------|------------------|
| 960 Winter | 2.20 | 742 |
| 1440 Winter | 1.66 | 1048 |
| 2160 Winter | 1.25 | 1496 |
| 2880 Winter | 1.03 | 1916 |
| 4320 Winter | 0.78 | 2732 |
| 5760 Winter | 0.64 | 3520 |
| 7200 Winter | 0.55 | 4264 |
| 8640 Winter | 0.48 | 5016 |
| 10080 Winter | 0.43 | 5752 |

95 Bothwell Street
Glasgow
G2 7HX

COGGES LINK ROAD
WITNEY COGGES LINK ROAD
POND DESIGN



Date April 08
File SOURCE CONTROL CARRIAGEWAY-VERGE...

Designed By JCR
Checked By

Micro Drainage

Source Control W.11.2

Rainfall Details

| | | | |
|-----------------------|--------------------|-----------------------|-------|
| Region | FEH Rainfall Model | F (1km) | 2.414 |
| Return Period (years) | 1 | Cv (Summer) | 0.790 |
| Site Location | (Unknown) | Cv (Winter) | 0.840 |
| C (1km) | -0.023 | Shortest Storm (mins) | 15 |
| D1 (1km) | 0.320 | Longest Storm (mins) | 10080 |
| D2 (1km) | 0.308 | Summer Storms | Yes |
| D3 (1km) | 0.308 | Winter Storms | Yes |
| E (1km) | 0.284 | Climate Change % | +30 |

Time / Area Diagram

Total Area (ha) = 3.485

| Time (mins) | Area (ha) | Time (mins) | Area (ha) | Time (mins) | Area (ha) |
|-------------|-----------|-------------|-----------|-------------|-----------|
| from: | to: | from: | to: | from: | to: |
| 0 | 4 | 8 | 12 | 16 | 20 |
| | 0.126 | | 1.211 | | 0.086 |
| 4 | 8 | 12 | 16 | | |
| | 1.449 | | 0.613 | | |

95 Bothwell Street
Glasgow
G2 7HX

COGGES LINK ROAD
WITNEY COGGES LINK ROAD
POND DESIGN



Date April 08
File SOURCE CONTROL CARRIAGEWAY-VERGE...

Designed By JCR
Checked By

Micro Drainage

Source Control W.11.2

Tank/Pond Details

Invert Level (m) 77.700 Ground Level (m) 79.000

| Depth (m) | Area (m ²) | Depth (m) | Area (m ²) | Depth (m) | Area (m ²) | Depth (m) | Area (m ²) | Depth (m) | Area (m ²) | Depth (m) | Area (m ²) |
|-----------|------------------------|-----------|------------------------|-----------|------------------------|-----------|------------------------|-----------|------------------------|-----------|------------------------|
| 0.00 | 2311.8 | 0.50 | 2909.9 | 1.00 | 3521.9 | 1.50 | 4021.6 | 2.00 | 4021.6 | 2.50 | 4021.6 |
| 0.10 | 2430.4 | 0.60 | 3031.7 | 1.10 | 3645.9 | 1.60 | 4021.6 | 2.10 | 4021.6 | | |
| 0.20 | 2549.4 | 0.70 | 3153.0 | 1.20 | 3770.6 | 1.70 | 4021.6 | 2.20 | 4021.6 | | |
| 0.30 | 2669.0 | 0.80 | 3275.4 | 1.30 | 3985.8 | 1.80 | 4021.6 | 2.30 | 4021.6 | | |
| 0.40 | 2789.2 | 0.90 | 3398.4 | 1.40 | 4021.6 | 1.90 | 4021.6 | 2.40 | 4021.6 | | |

Orifice Outflow Control

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 77.700

Orifice Overflow Control

Diameter (m) 0.150 Discharge Coef 0.600 Invert Level (m) 78.500

Summary of Results for 100 year Return Period (+30%)

| Storm Duration (mins) | Maximum Control (l/s) | Maximum Overflow (l/s) | Maximum Outflow (l/s) | Maximum Water Level (m OD) | Maximum Depth (m) | Overflow Volume (m³) | Maximum Volume (m³) | Status |
|-----------------------|-----------------------|------------------------|-----------------------|----------------------------|-------------------|----------------------|---------------------|--------|
| 15 Summer | 12.8 | 0.0 | 12.8 | 78.1233 | 0.4232 | 0.0 | 1084.4 | 0 K |
| 30 Summer | 13.7 | 0.0 | 13.7 | 78.1822 | 0.4822 | 0.0 | 1253.1 | 0 K |
| 60 Summer | 14.7 | 0.0 | 14.7 | 78.2463 | 0.5462 | 0.0 | 1441.3 | 0 K |
| 120 Summer | 15.7 | 0.0 | 15.7 | 78.3138 | 0.6138 | 0.0 | 1643.6 | 0 K |
| 180 Summer | 16.2 | 0.0 | 16.2 | 78.3523 | 0.6523 | 0.0 | 1762.7 | 0 K |
| 240 Summer | 16.6 | 0.0 | 16.6 | 78.3788 | 0.6788 | 0.0 | 1844.1 | 0 K |
| 360 Summer | 17.0 | 0.0 | 17.0 | 78.4113 | 0.7113 | 0.0 | 1947.2 | 0 K |
| 480 Summer | 17.2 | 0.0 | 17.2 | 78.4298 | 0.7298 | 0.0 | 2005.8 | 0 K |
| 600 Summer | 17.3 | 0.0 | 17.3 | 78.4403 | 0.7403 | 0.0 | 2038.6 | 0 K |
| 720 Summer | 17.4 | 0.0 | 17.4 | 78.4453 | 0.7453 | 0.0 | 2054.4 | 0 K |
| 960 Summer | 17.4 | 0.0 | 17.4 | 78.4443 | 0.7443 | 0.0 | 2052.3 | 0 K |
| 1440 Summer | 17.3 | 0.0 | 17.3 | 78.4398 | 0.7398 | 0.0 | 2037.0 | 0 K |
| 2160 Summer | 17.2 | 0.0 | 17.2 | 78.4253 | 0.7253 | 0.0 | 1992.0 | 0 K |
| 2880 Summer | 16.9 | 0.0 | 16.9 | 78.4063 | 0.7063 | 0.0 | 1930.3 | 0 K |
| 4320 Summer | 16.3 | 0.0 | 16.3 | 78.3623 | 0.6623 | 0.0 | 1792.3 | 0 K |
| 5760 Summer | 15.7 | 0.0 | 15.7 | 78.3178 | 0.6178 | 0.0 | 1656.7 | 0 K |
| 7200 Summer | 15.2 | 0.0 | 15.2 | 78.2773 | 0.5773 | 0.0 | 1532.9 | 0 K |
| 8640 Summer | 14.6 | 0.0 | 14.6 | 78.2398 | 0.5397 | 0.0 | 1421.6 | 0 K |
| 10080 Summer | 14.1 | 0.0 | 14.1 | 78.2063 | 0.5062 | 0.0 | 1322.7 | 0 K |
| 15 Winter | 13.2 | 0.0 | 13.2 | 78.1472 | 0.4472 | 0.0 | 1153.4 | 0 K |
| 30 Winter | 14.2 | 0.0 | 14.2 | 78.2097 | 0.5097 | 0.0 | 1333.2 | 0 K |
| 60 Winter | 15.2 | 0.0 | 15.2 | 78.2772 | 0.5772 | 0.0 | 1533.8 | 0 K |
| 120 Winter | 16.2 | 0.0 | 16.2 | 78.3488 | 0.6488 | 0.0 | 1750.8 | 0 K |
| 180 Winter | 16.7 | 0.0 | 16.7 | 78.3898 | 0.6898 | 0.0 | 1879.3 | 0 K |
| 240 Winter | 17.1 | 0.0 | 17.1 | 78.4178 | 0.7178 | 0.0 | 1967.4 | 0 K |
| 360 Winter | 17.5 | 0.0 | 17.5 | 78.4533 | 0.7533 | 0.0 | 2080.5 | 0 K |
| 480 Winter | 17.8 | 0.0 | 17.8 | 78.4738 | 0.7738 | 0.0 | 2146.8 | 0 K |
| 600 Winter | 17.9 | 0.0 | 17.9 | 78.4858 | 0.7858 | 0.0 | 2186.2 | 0 K |
| 720 Winter | 18.0 | 0.0 | 18.0 | 78.4923 | 0.7923 | 0.0 | 2208.1 | 0 K |

| Storm Duration (mins) | Rain (mm/hr) | Time-Peak (mins) |
|-----------------------|--------------|------------------|
| 15 Summer | 159.52 | 31 |
| 30 Summer | 92.53 | 45 |
| 60 Summer | 53.67 | 74 |
| 120 Summer | 31.13 | 132 |
| 180 Summer | 22.64 | 192 |
| 240 Summer | 18.06 | 250 |
| 360 Summer | 13.13 | 368 |
| 480 Summer | 10.47 | 486 |
| 600 Summer | 8.79 | 606 |
| 720 Summer | 7.62 | 724 |
| 960 Summer | 6.05 | 862 |
| 1440 Summer | 4.38 | 1100 |
| 2160 Summer | 3.17 | 1496 |
| 2880 Summer | 2.52 | 1908 |
| 4320 Summer | 1.82 | 2728 |
| 5760 Summer | 1.45 | 3528 |
| 7200 Summer | 1.21 | 4328 |
| 8640 Summer | 1.05 | 5104 |
| 10080 Summer | 0.93 | 5856 |
| 15 Winter | 159.52 | 31 |
| 30 Winter | 92.53 | 45 |
| 60 Winter | 53.67 | 74 |
| 120 Winter | 31.13 | 130 |
| 180 Winter | 22.64 | 188 |
| 240 Winter | 18.06 | 246 |
| 360 Winter | 13.13 | 362 |
| 480 Winter | 10.47 | 476 |
| 600 Winter | 8.79 | 590 |
| 720 Winter | 7.62 | 702 |

Summary of Results for 100 year Return Period (+30%)

| Storm Duration (mins) | Maximum Control (l/s) | Maximum Overflow (l/s) | Maximum Outflow (l/s) | Maximum Water Level (m OD) | Maximum Depth (m) | Overflow Volume (m ³) | Maximum Volume (m ³) | Status |
|-----------------------|-----------------------|------------------------|-----------------------|----------------------------|-------------------|-----------------------------------|----------------------------------|------------|
| 960 Winter | 18.0 | 0.0 | 18.0 | 78.4933 | 0.7933 | 0.0 | 2210.9 | 0 K |
| 1440 Winter | 17.9 | 0.0 | 17.9 | 78.4818 | 0.7818 | 0.0 | 2173.5 | 0 K |
| 2160 Winter | 17.6 | 0.0 | 17.6 | 78.4603 | 0.7603 | 0.0 | 2102.9 | 0 K |
| 2880 Winter | 17.2 | 0.0 | 17.2 | 78.4308 | 0.7308 | 0.0 | 2008.7 | 0 K |
| 4320 Winter | 16.4 | 0.0 | 16.4 | 78.3668 | 0.6668 | 0.0 | 1806.3 | 0 K |
| 5760 Winter | 15.5 | 0.0 | 15.5 | 78.3048 | 0.6048 | 0.0 | 1616.5 | 0 K |
| 7200 Winter | 14.7 | 0.0 | 14.7 | 78.2488 | 0.5487 | 0.0 | 1448.5 | 0 K |
| 8640 Winter | 14.0 | 0.0 | 14.0 | 78.1992 | 0.4992 | 0.0 | 1302.9 | 0 K |
| 10080 Winter | 13.3 | 0.0 | 13.3 | 78.1557 | 0.4557 | 0.0 | 1176.8 | 0 K |

| Storm Duration (mins) | Rain (mm/hr) | Time-Peak (mins) |
|-----------------------|--------------|------------------|
| 960 Winter | 6.05 | 916 |
| 1440 Winter | 4.38 | 1144 |
| 2160 Winter | 3.17 | 1604 |
| 2880 Winter | 2.52 | 2056 |
| 4320 Winter | 1.82 | 2940 |
| 5760 Winter | 1.45 | 3752 |
| 7200 Winter | 1.21 | 4552 |
| 8640 Winter | 1.05 | 5360 |
| 10080 Winter | 0.93 | 6152 |

Rainfall Details

| | | | |
|-----------------------|--------------------|-----------------------|-------|
| Region | FEH Rainfall Model | F (1km) | 2.414 |
| Return Period (years) | 100 | Cv (Summer) | 0.790 |
| Site Location | (Unknown) | Cv (Winter) | 0.840 |
| C (1km) | -0.023 | Shortest Storm (mins) | 15 |
| D1 (1km) | 0.320 | Longest Storm (mins) | 10080 |
| D2 (1km) | 0.308 | Summer Storms | Yes |
| D3 (1km) | 0.308 | Winter Storms | Yes |
| E (1km) | 0.284 | Climate Change % | +30 |

Time / Area Diagram

Total Area (ha) = 3.485

| Time (mins) | Area (ha) | Time (mins) | Area (ha) | Time (mins) | Area (ha) |
|-------------|-----------|-------------|-----------|-------------|-----------|
| from: | to: | from: | to: | from: | to: |
| 0 | 4 | 0.126 | 8 | 12 | 1.211 |
| 4 | 8 | 1.449 | 12 | 16 | 0.613 |
| | | | | 16 | 20 |
| | | | | | 0.086 |

95 Bothwell Street
Glasgow
G2 7HX

COGGES LINK ROAD
WITNEY COGGES LINK ROAD
POND DESIGN



Date April 08
File SOURCE CONTROL CARRIAGEWAY-VERGE...

Designed By JCR
Checked By

Micro Drainage

Source Control W.11.2

Tank/Pond Details

Invert Level (m) 77.700 Ground Level (m) 79.000

| Depth (m) | Area (m ²) | Depth (m) | Area (m ²) | Depth (m) | Area (m ²) | Depth (m) | Area (m ²) | Depth (m) | Area (m ²) | Depth (m) | Area (m ²) |
|-----------|------------------------|-----------|------------------------|-----------|------------------------|-----------|------------------------|-----------|------------------------|-----------|------------------------|
| 0.00 | 2311.8 | 0.50 | 2909.9 | 1.00 | 3521.9 | 1.50 | 4021.6 | 2.00 | 4021.6 | 2.50 | 4021.6 |
| 0.10 | 2430.4 | 0.60 | 3031.7 | 1.10 | 3645.9 | 1.60 | 4021.6 | 2.10 | 4021.6 | | |
| 0.20 | 2549.4 | 0.70 | 3153.0 | 1.20 | 3770.6 | 1.70 | 4021.6 | 2.20 | 4021.6 | | |
| 0.30 | 2669.0 | 0.80 | 3275.4 | 1.30 | 3985.8 | 1.80 | 4021.6 | 2.30 | 4021.6 | | |
| 0.40 | 2789.2 | 0.90 | 3398.4 | 1.40 | 4021.6 | 1.90 | 4021.6 | 2.40 | 4021.6 | | |

Orifice Outflow Control

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 77.700

Orifice Overflow Control

Diameter (m) 0.150 Discharge Coef 0.600 Invert Level (m) 78.500

Appendix 6

Drawing No 0834600/Doc/PA/CLR/09/02
Long section at scales 1:2500 Horizontal and 1:250 Vertical

Appendix 7

Drawing No 0834600/Doc/PA/CLR/09/03 - 04
Preliminary Drainage Layout

Appendix 8

Assessment of Pollution Impacts from Routine Runoff

Cogges Link Road

Preliminary Drainage Design

Method A - Simple Assessment of Pollution Impacts from Routine runoff

| | | |
|--------------------------------|-------------------------|---|
| 95%ile river flow (Q_{95}) | 0.736 m ³ /s | <i>Guaged flow of windrush at Newbridge</i> |
| River Ecosystem Class | RE1 | <i>from EA records</i> |
| Road Width | 7.3 m | |
| Road length | 2000 m | |
| AADT for two-way flow | 17000 veh / day | <i>traffic data</i> |
| Runoff coefficient | 0.79 cv | |

from Fig A1 Rainfall depth, d

9 mm

Road area

14600 m²

Runoff volume from highway, V_h Runoff Coeff * d* Road area

$$= 103.806$$

River flow daily Volume V_r

$$3600 \times 24 \times Q_{95}$$

$$= 63590.4$$

Dilution, D

$$= V_r / V_h$$

$$= 612.589$$

Conclusion:

Using figure A.2 it can be seen that when AADT is 17000 and dilution 612, the result indicates that no further assessment is required, as the dilution exceeds the minimum requirement level for impacts from routine runoff on a RE1 watercourse. (612 > 6.4)

Cogges Link Road. - Assessment of Pollution Impacts of Routine Run off

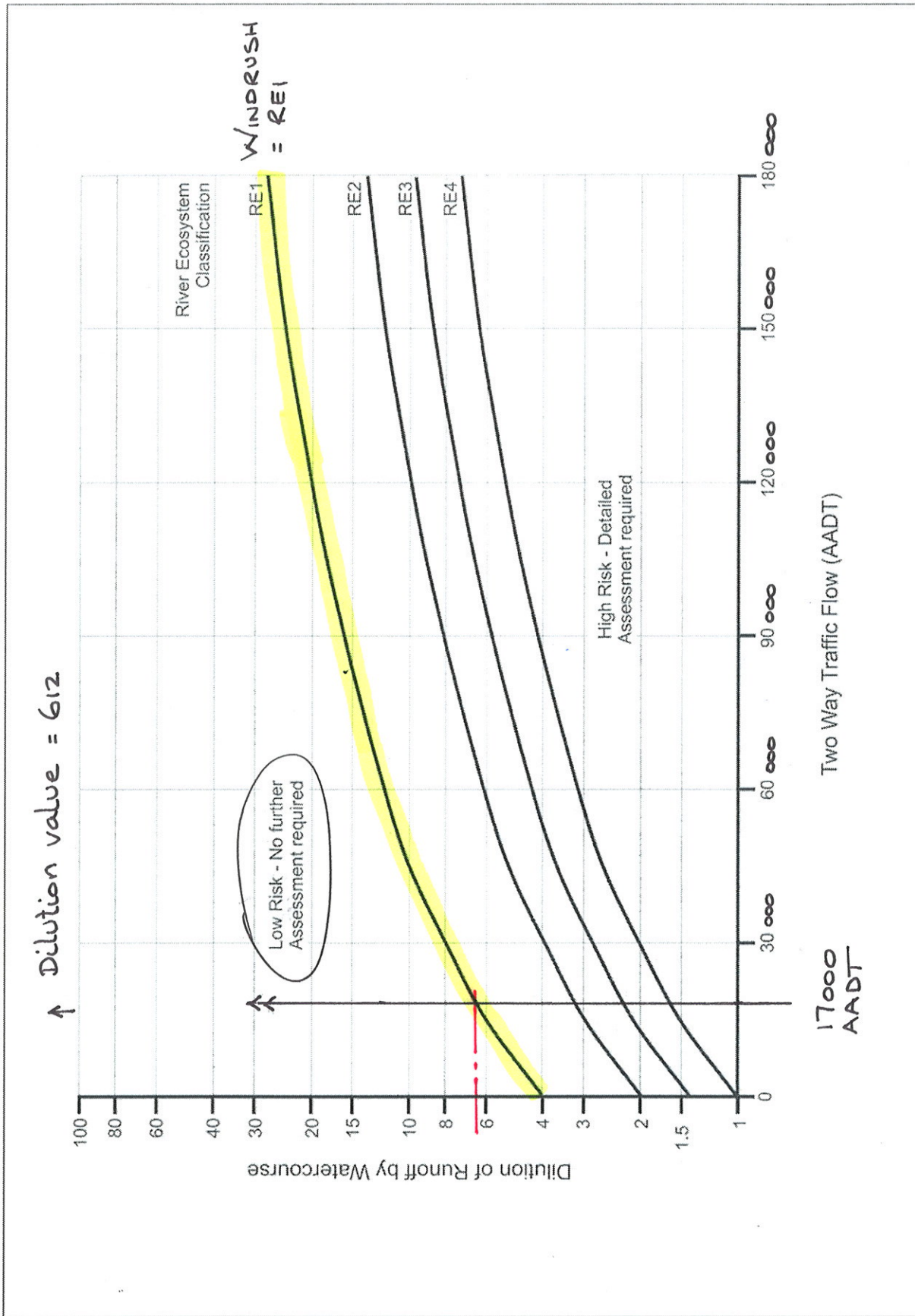



Figure A.2 - Graph to Determine Risk of Impact of Pollution from Routine Runoff

Method A

39006 - Windrush at Newbridge

Grid Reference: 42 (SP) 402 019 
Operator: EA
Local number: 1090
Catchment Area: 362.6 km²
Level of Station: 63.4 mOD
Max. Altitude: 319.0 mOD
Mean flow: 3.31 m³s⁻¹
95% exceedance (Q95): 0.736 m³s⁻¹
10% exceedance (Q10): 6.65 m³s⁻¹
61-90 Av. Ann. Rainfall: 743 mm

Sample Hydrograph of Gauged Daily Flows



Flow Duration Curve for Gauged Daily Flows



Station Description

Compound broad-crested weir (total crest width 8.3m) with complementary side-spilling weir (14.9m wide) into bypass channel. Subject to drowning; unreliable at high flows. Early data may be overestimated due to lack of weed cutting. From 1962 a calibration based upon gaugings was adopted. Improvements in the method of water level measurement made in 1969. Runoff diminished by a small net export of water (minor bypassing via side channels also occurs).

Catchment Description

A predominantly pervious (Oolitic L'st) catchment on the dip-slope of the Cotswolds. Mainly rural. Gravel pit development in the lower valley.

Factors Affecting Runoff

- Runoff reduced by public water supply abstraction.
- Runoff influenced by groundwater abstraction/recharge.
- Runoff reduced by industrial/agricultural abstraction.

River Flow and Catchment Rainfall on the National River Flow Archive

Gauged Daily Flows (gdf): 1950 to 2004

Cogges Link Road.

Annex I
Assessment Methods

Assessment of Pollution Impacts of Method A. Routine Runoff

Volume 11 Section 3
Part 10 HA 216/06

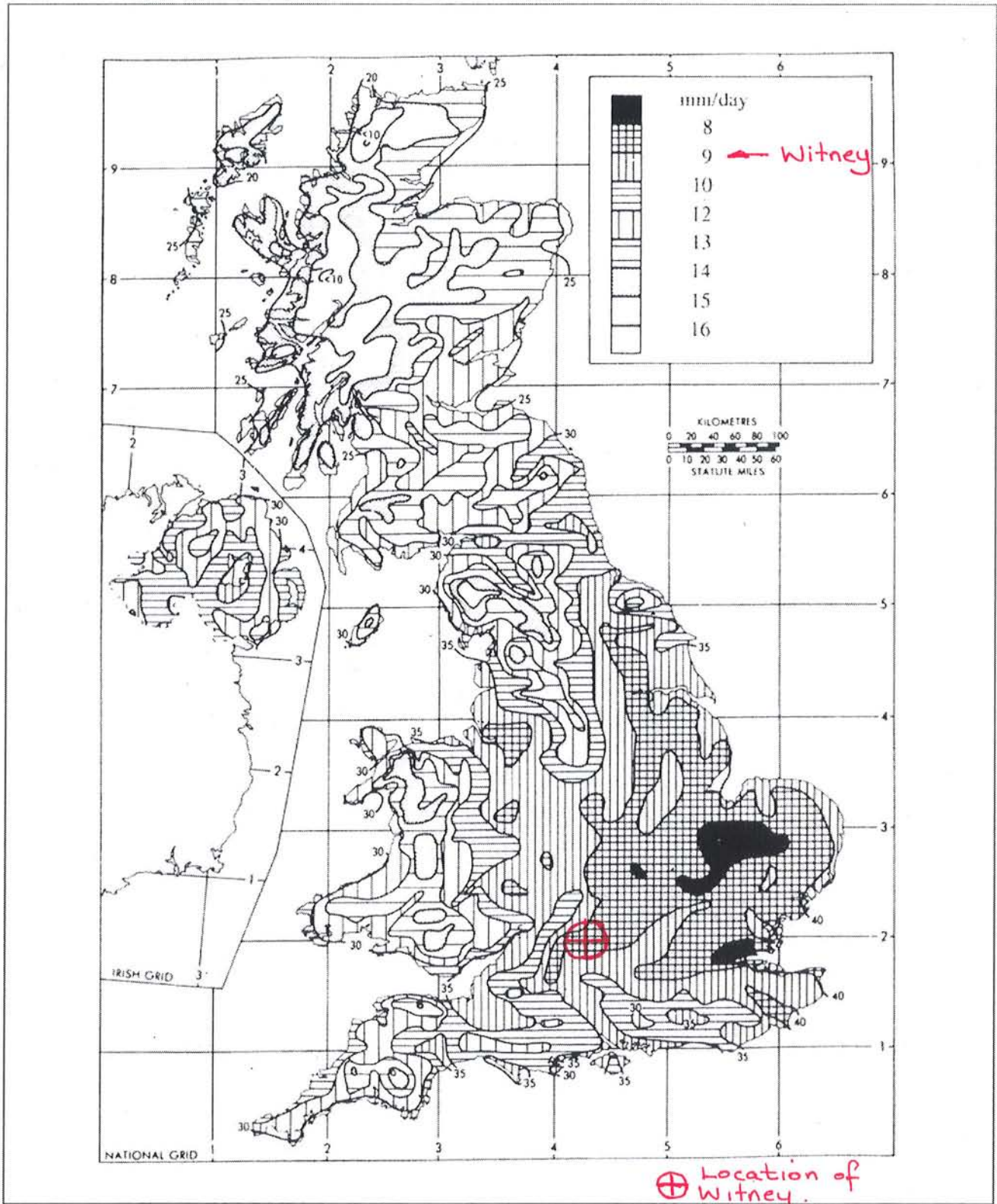


Figure A.1 – Depth of Rain for Assessing Pollutant Runoff

Reproduced from 'The Wallingford Procedure – Volume 1' by kind permission of HR Wallingford

Cogges Link Road

Preliminary Drainage Design

Method B - Detailed Assessment of Pollution Impacts from Routine Runoff

This assessment is not required as the scheme proposals do not discharge routine run off

Cogges Link Road

Preliminary Drainage Design

Method C - Assessment of Pollution Impacts from Routine run off on Groundwaters

This assessment is not required as the scheme proposals do not discharge routine run off

Appendix 9

Assessment of Pollution Impacts from Accidental Spillage

Cogges Link Road

Preliminary Drainage Design

Method D - Assessment of Pollution Impacts from Accidental Spillage

| Annual Probability | | | | | |
|--------------------|---|---|------------|-------------|-------------------------------|
| P_{ACC} | = | $RL \times SS \times (AADT \times 365 \times 10^{-9}) \times (\%HGV / 100)$ | | | |
| P_{ACC} | = | annual probability of an accidental spillage with the potential to cause a serious pollution incident | Roundabout | No Junction | Traffic Signals |
| RL | = | road length in Kilometres | = 0.1 | 1.7 | 0.2 |
| SS | = | Spillage rate from table D.1 | = 5.35 | 0.31 | 1.81 |
| AADT | = | annual average daily traffic (use design year for new roads) | = 17000 | 17000 | 17000 |
| %HGV | = | percentage of heavy goods vehicles | = 2 | 2 | 2 |
| \therefore | | $P_{ACC} =$ | 6.639E-05 | 6.540E-05 | 4.492E-05 |
| | | | | | Total $P_{ACC} = 0.000176718$ |

Calculate predicted annual probability

$P_{INC} = P_{ACC} \times P_{POL}$ where :

P_{INC} = the probability of a spillage accident with an associated risk of a serious pollution incident occurring

P_{POL} = the probability, given an accident, that a serious pollution incident will result. An appropriate value for this is to be selected from Table D.2 This will depend on the sensitivity of the water course and how soon it can be reached by the emergency services.

Value from Table D.2

using River Quality RE1& Urban location response time 0.45 less than 20 minutes

$\therefore P_{INC} = 0.000176718 \times 0.45$

$P_{INC} = 7.952E-05$

as the probability P_{INC} is less than the acceptable risk of 1% then pollution risk from spillage is not an issue. No mitigation is required as a result of this assessment.

Cogges Link Road.
Assessment of Pollution Impact
from Accidental Spillage.

using the appropriate risk reduction factor for the measure selected. Chapter 7 gives factors to be used.

D.10 Recalculate the overall risk to each reach by adding all the revised individual outfall risks. Where necessary mitigation measures are to be included at other outfalls, until an acceptable overall risk for each reach is achieved.

D.11 In some, rare, instances, two forms of mitigation may be required to reduce the probability to an acceptable level of risk. Where this occurs, the two forms of mitigation should be complementary and should not rely on the same mechanisms for their effect. At least one should be a passive system, as described in Chapter 7.

Cogges Link Road.

| | Motorways | Rural Trunk Roads | Urban Trunk Roads |
|-------------|-----------|-------------------|-------------------|
| No Junction | 0.36 | 0.29 | 0.31 |
| Slip Road | 0.43 | 0.83 | 0.36 |
| Roundabout | | 3.09 | 5.35 |
| Cross road | | 0.88 | 1.46 |
| Side Road | | 0.93 | 1.81 |
| Total | 0.37 | 0.45 | 0.85 |

The risk factor applies to all road lengths within 100m of these junction types. So for a side road joining an urban trunk road the factor is 1.81 for 100m of the side road and for a 200m length of the trunk road, centred on the junction.

Table D.1 – Serious Accidental Spillages in Billion HG V km/year

Cogges Link Road.

| Water Quality Objective of Receiving Watercourse | Urban (response time to site < 20 minutes) | Rural (response time to site < 1 hour) | Remote (response time to site > 1 hour) |
|---|--|--|---|
| Windrush Surface watercourse RE 1 or RE 2 (high quality) | 0.45 | 0.6 | 0.75 |
| Surface watercourse RE 3 or RE 4 (moderate quality) | 0.3 | 0.4 | 0.5 |
| Groundwater | 0.3 | 0.3 | 0.5 |

Table D.2 – Probability of a Serious Pollution Incident Occurring as a Result of a Serious Accidental Spillage